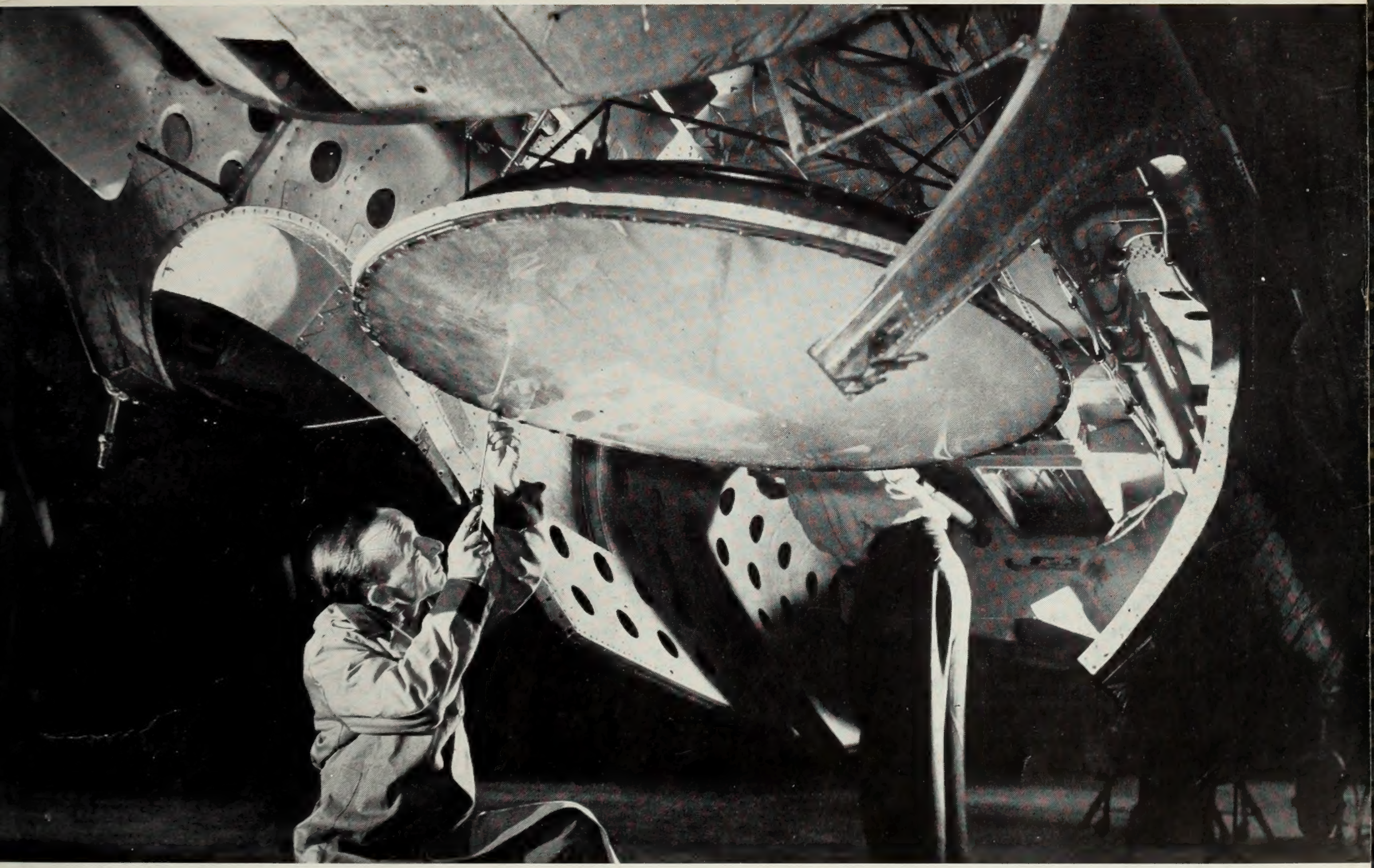
THE ENGINEERING JOURNAL

VOLUME 39 NUMBER 1
JANUARY 1956

THE ENGINEERING INSTITUTE OF CANADA
FOUNDED 1887



In This Issue—

- Boilers and Their Auxiliaries
- Photoelasticity for Design Improvement
- Radar Echoes from Aurora
- Sanitation for Metropolitan Toronto

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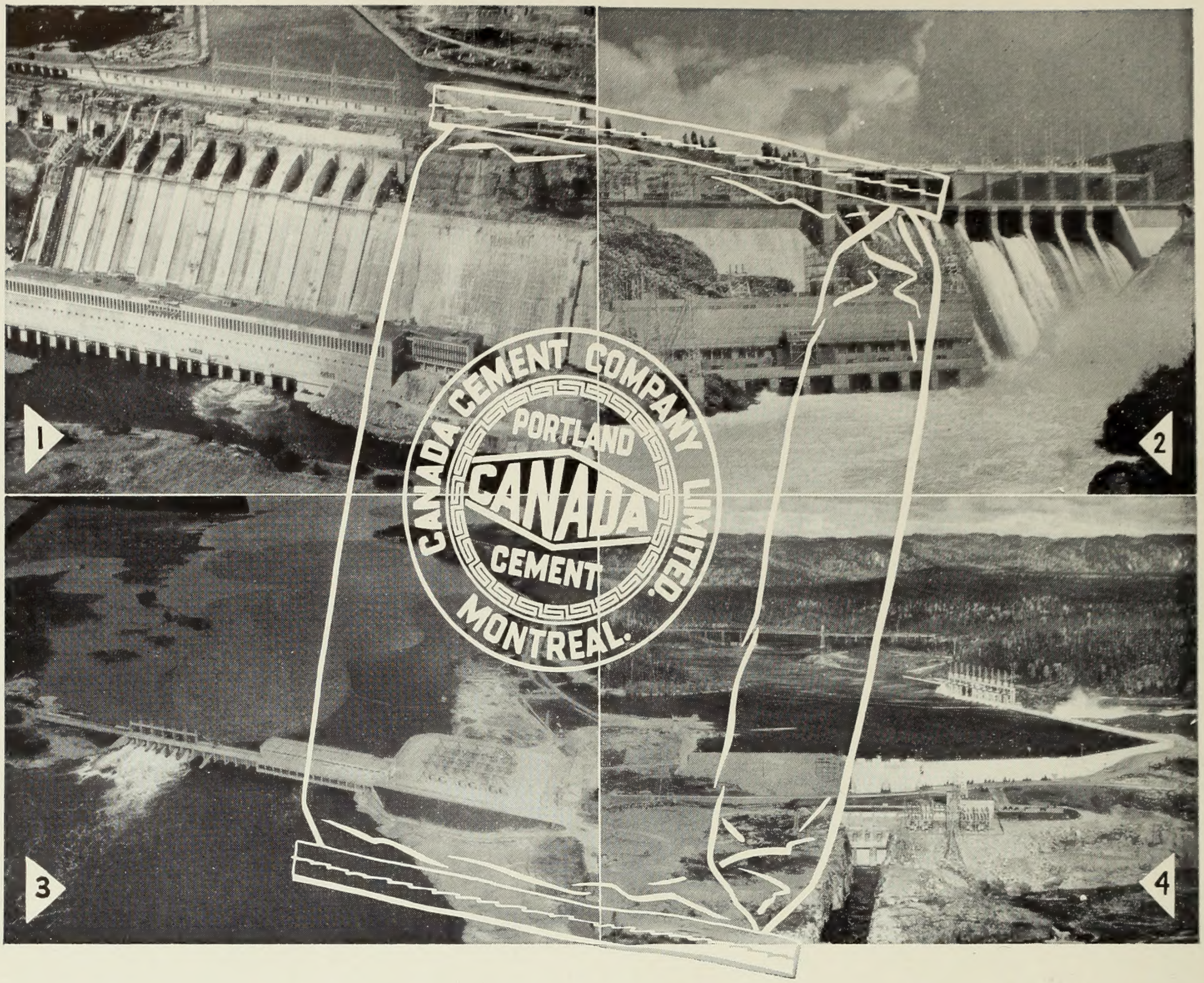
THE ENGINEERING INSTITUTE of CANADA



1,750,000 cubic yards of concrete were required for *Sir Adam Beck-Niagara Generating Station No. 2* development. This concrete was used to line two 5½ mile hydraulic tunnels, for an open canal, forebay, headworks, powerhouse and penstocks.

Two million sacks of cement were used in constructing the *Waneta Dam* of Consolidated Mining and Smelting Company of Canada, Limited, near Trail, B.C. The dam is 950 feet long at the deck, 250 feet high from the riverbed and has a 210-ft. head of water. Four penstock tunnels 200-ft. long and 20 ft. in diameter carry the water from the reservoir to the power plant.

Aerial view of the *Pine Falls Power Development* on the Winnipeg River owned by the Manitoba Electric Power Commission. Pine Falls (114,000 h.p.) is one of four developments on the same river. The others are Seven Sisters (225,000 h.p.), Great Falls (168,000 h.p.) and McArthur Falls (80,000 h.p.).

Manicougan River power development near Baie Comeau some 95 miles down the St. Lawrence from Quebec City is said to include the largest unwatering channel operation yet attempted. The channel is 1,600 ft. long, running to a depth of 115 ft. and a minimum width of 40 ft.

Concrete...Power...Progress...

Since World War II many million sacks of "Canada" cement have gone into Canada's hydro-electric developments.

They have gone into dams and powerhouses, bulkheads, sluices, tunnel linings, flood channels, penstocks, casings and gatehouses. Thus "Canada" cement has been and will continue to be a vital factor in harnessing this country's abundant water power to build a greater and more prosperous Canada.

To meet the demand for its products, Canada Cement Company has almost doubled the overall productive capacity of its seven plants during the last ten years.

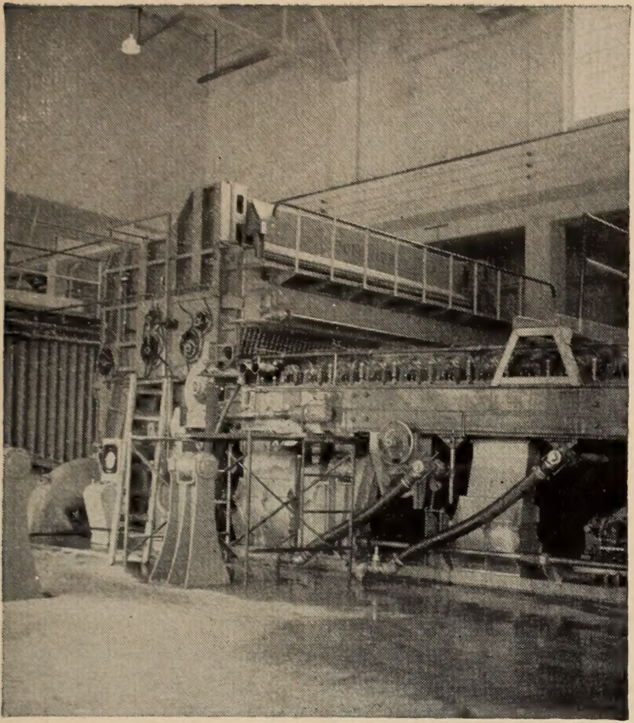
"Canada" cement has been produced in this country for many years and time has proved it to be the best to meet the special requirements of Canadian conditions.

For assured results, specify "Canada" Cement.

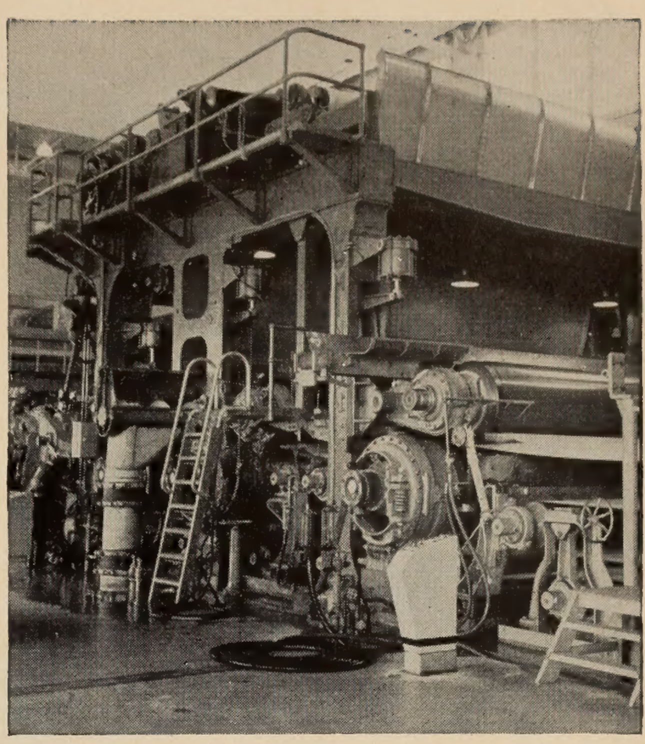
Canada Cement Company Limited

CANADA CEMENT BUILDING, PHILLIPS SQUARE, MONTREAL

SALES OFFICES: MONCTON, QUEBEC, MONTREAL, OTTAWA, TORONTO, WINNIPEG, CALGARY



DOMINION PRESSURE TYPE HEAD BOX feeds the stock efficiently ensuring good formation on the wire at any operating speed.



DOMINION COUCH VACUUM TRANSFER, another design feature contributing to the overall operating efficiency and output.

2,022.6 TONS OF NEWSPRINT IN 6⅔ DAYS!

A typical run for a Dominion Vacuum Transfer equipped 284" newsprint machine.

This machine is equipped with a Dominion Pressure Type Head Box and Couch Vacuum Transfer incorporating a Screw Type Broke Conveyor-Pulper. The latter not only removes broke from the Press section but also reduces it to pulp and returns it automatically to the Couch Pit. 2,022.6 Tons of Commercial Newsprint produced in 6 2/3 days is an enviable performance but one that will be surpassed as this machine and others of its type are brought to their design speeds. This is achieved through close liaison between the paper makers of Canadian Mills and the Engineers and Designers at Dominion Engineering.

Paper division
Dominion Engineering Company, Limited
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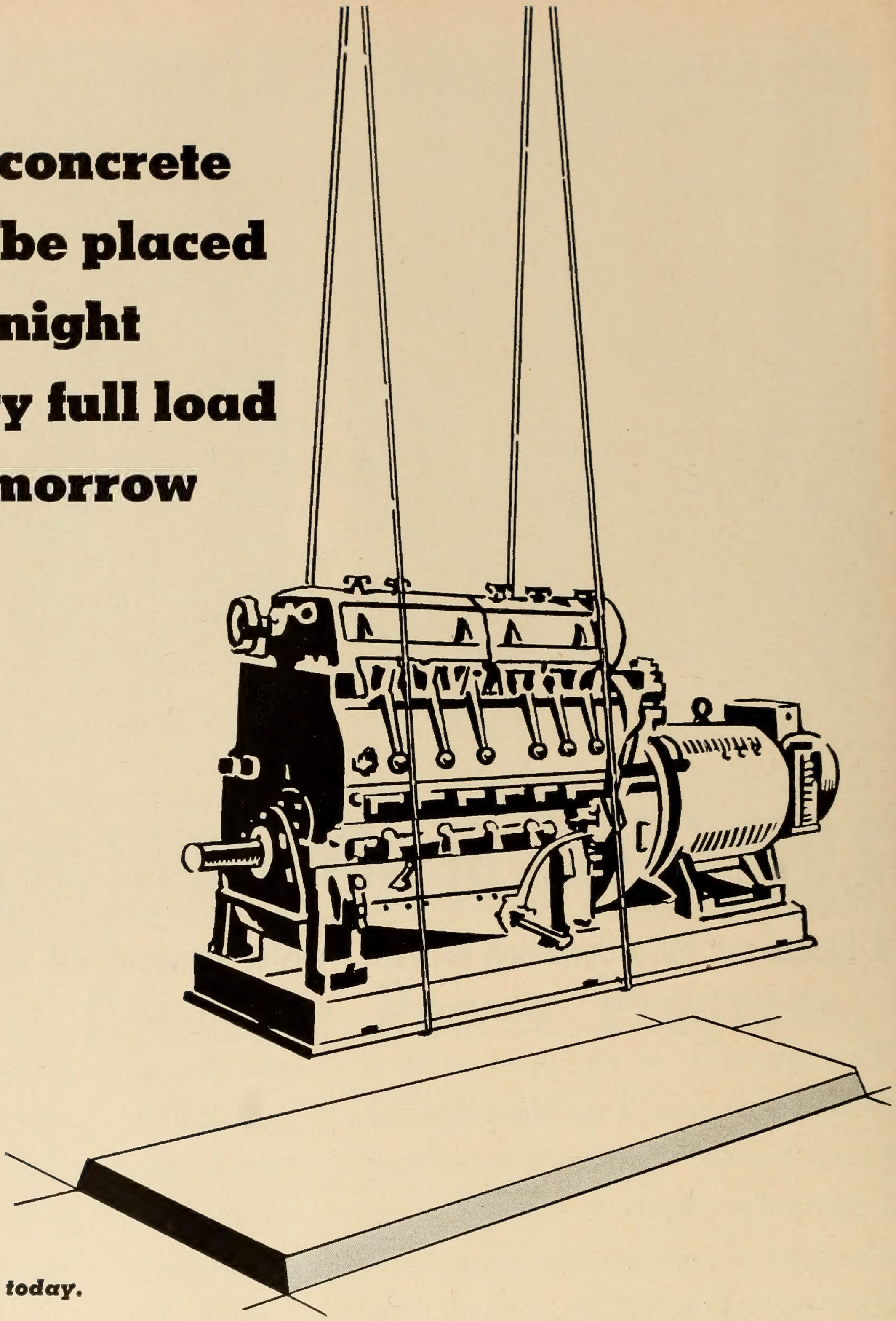
Fondu concrete can be placed tonight and carry full load tomorrow



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T-5-1

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Assure getting maximum efficiency from your steam equipment by specifying Dominion Coal.

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A Division of
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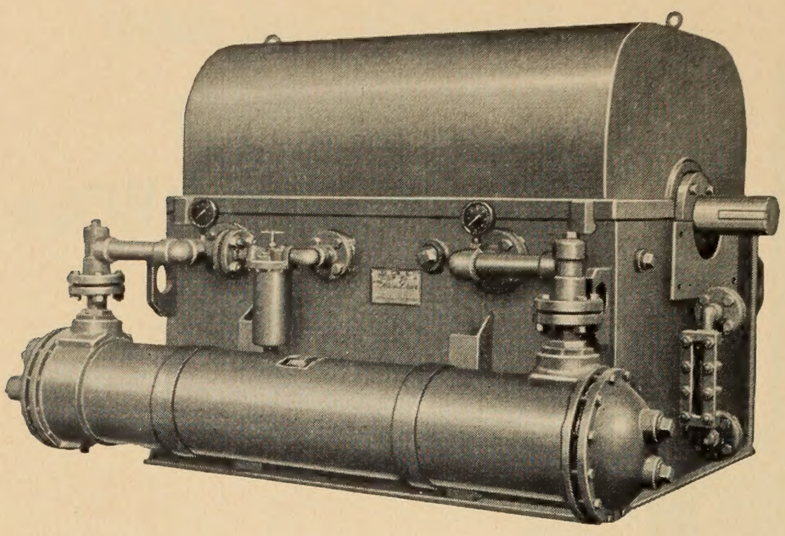
Improve over-all power plant efficiency with...
GÝROL FLUID DRIVES FOR MECHANICAL DRAFT FANS



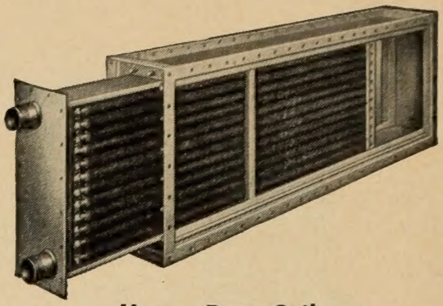
Type VS Gýrol Fluid Drive for Mechanical Draft Fans

The smooth flow of power and adjustable speed features of Gýrol Fluid Drives for Mechanical Draft Fans offer substantial power savings, quieter operation and, where erosion occurs, increased life of wheel and housing.

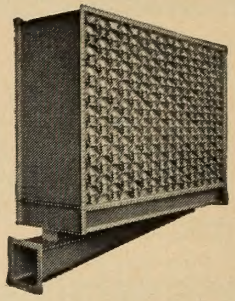
For complete information on Gýrol Fluid Drives for Mechanical Draft Fans, write for our Bulletin 9319.

And if you'd like data on Canadian Sirocco Mechanical Draft Fans, Fly Ash Precipitators, Heavy Duty Coils and Gýrol Fluid Drive for boiler feed pumps — write, stating your requirements, or phone the nearest Canadian Sirocco Branch Office.

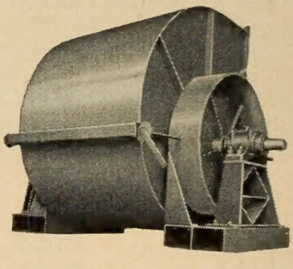
CANADIAN SIROCCO COMPANY, LTD.
310 ELLIS STREET, WINDSOR, ONTARIO



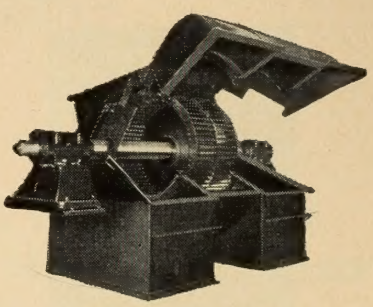
Heavy Duty Coils



Type ST Fly Ash Precipitators



Canadian HS Forced Draft Fans



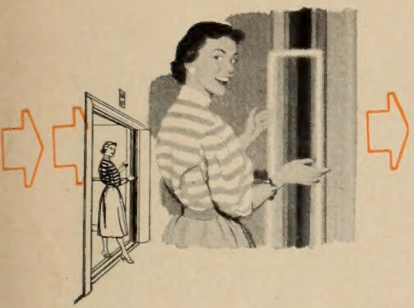
Sirocco Induced Draft Fans

YOUR BEST BUY CANADIAN SIROCCO POWER PLANT EQUIPMENT

In the United States: AMERICAN BLOWER CORPORATION • DETROIT 32, MICHIGAN

NOW! a touch of excitement in the car

The dramatic Otis Electronic *Touch* Button—*which makes AUTOTRONIC® elevators respond to your floor calls*—is now available for car operating panels. Signaling for the floor you want is an exciting and somewhat mystifying experience with the Otis Electronic *Touch* Button Panel. Nothing moves. A mere touch of a finger lights your floor number button. What makes it work? The Otis Electronic *Touch* Button has no moving parts or contacts. There's an electronic tube behind each floor number. A simple touch excites the tube and lights it to show that your call has been registered. Then as the car arrives at your floor, the call is cancelled; the tube stops conducting and goes dark. Simple — *and dramatic AUTOTRONIC elevatoring!*

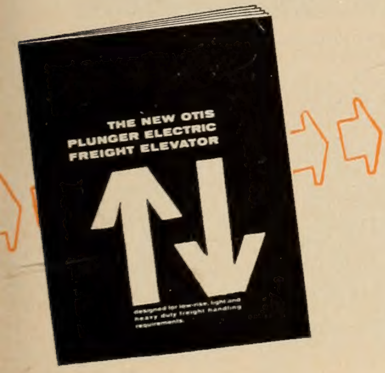


unmatched elevator door safety

It's always well to remember that every elevator entrance has two doors. First, the hoistway door; and second, the elevator car door. This is of utmost importance, because passengers in high speed operatorless elevators should always be protected from both doors—*for the highest degree of safety!* Only Otis Electronic Elevator Doors *with the electronic zone of detection* (as illustrated in phantom) provide double-door protection—as described in Otis booklet B-807. This unmatched safety—*obtainable only with completely automatic AUTOTRONIC elevators*—is available at only slightly extra cost above such standard equipment as rubber-edged contact doors, electric rays, and single-door protection.

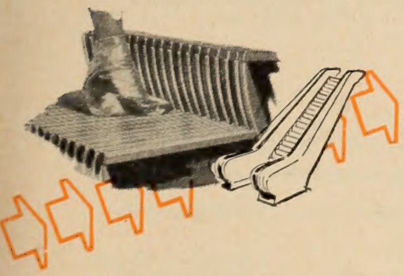
race track owners play "comfort to win"

Horse racing fans walk an average of three miles a day at the track. They're constantly on the move to and from the saddling paddock, the mutuel windows, the track rail and the points of refreshment during an eight race program. With patron comfort in mind, many of the leading tracks have installed Otis Escalators to eliminate all stair climbing.



FREE BOOKLET! hydraulic freight elevators

You'll find a complete description of the NEW Otis Plunger Electric Freight Elevators in Booklet A-414. It lists typical sizes from a light duty type with 2,500 lbs. capacity and manually operated car gates up to 20,000 lb. power truck elevators with time saving, power operated doors. It details the new Otis compact, self-contained power unit that makes possible smooth starts and stops and automatic leveling within ¼" of floor level. It shows how the Otis Plunger Electric Freight Elevators, which require no penthouse, keep all direct heavy vertical loads off the building structure and simplify the hoistway construction. There's no real limit to the size, capacity or use of the Plunger Electric elevators described in Booklet A-414.



stepping safety with style

Because those floppy new plastic women's overshoes can—*and sometimes do*—get stuck between the steps of escalators, Otis engineers have come up with a new safety step. It's cleated in a way to prevent such a mishap. It's now available for new installations.

OTIS ELEVATOR COMPANY LIMITED
Head Office and Works: Hamilton, Ontario
OFFICES AND SERVICE IN 26 CITIES ACROSS CANADA.

directional arrows
for
VERTICAL TRANSPORTATION

- PASSENGER ELEVATORS
- ESCALATORS
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- CARS AND ENTRANCES
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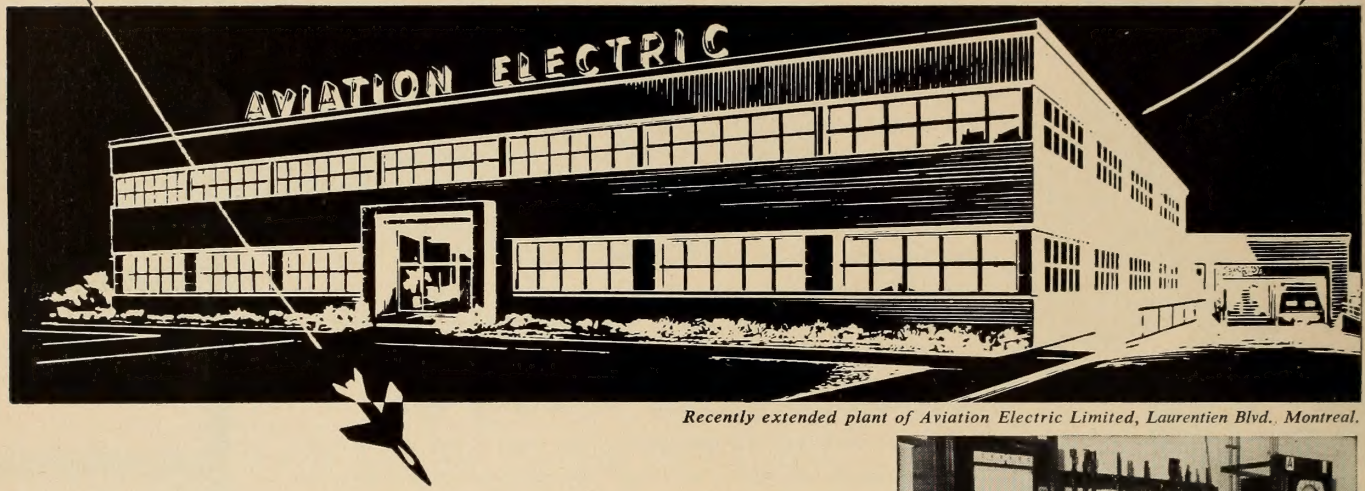
is second nature
the choice is

BRISTOL DYNAMASTER

for accurate temperature control

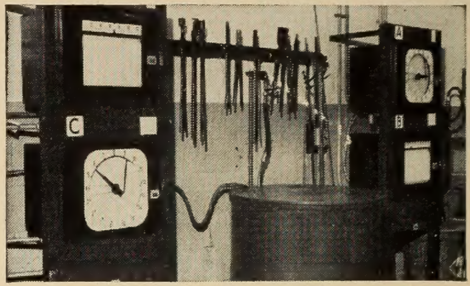


Recently extended plant of Aviation Electric Limited, Laurentien Blvd., Montreal.

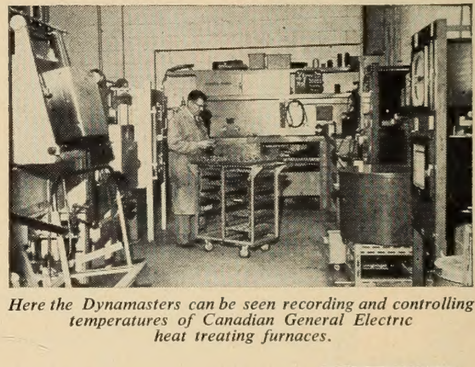
At Aviation Electric Limited, Montreal, high precision is basic. Makers of aircraft instruments and components for today's most advanced supersonic planes, they cannot afford the possibility of the slightest unreliability in the measuring, recording and controlling of their processes. Like the leaders in every field of industry Aviation Electric chose Bristol Dynamaster to guarantee absolute accuracy. When you choose Dynamaster for your own measuring needs, you are assured of the same matchless accuracy year after year.

Available as a bridge or potentiometer, with strip or circular charts, Dynamasters can measure any variable that can be converted into changes in d-c voltage, d-c current, resistance or capacitance.

For detailed proof of the sensitivity, versatility and reliability of the electronic Dynamaster, write for Catalogue P1245.



Close-up o, four Bristol Dynamasters in use at Aviation Electric.



Here the Dynamasters can be seen recording and controlling temperatures of Canadian General Electric heat treating furnaces.

The BRISTOL Company of Canada Limited

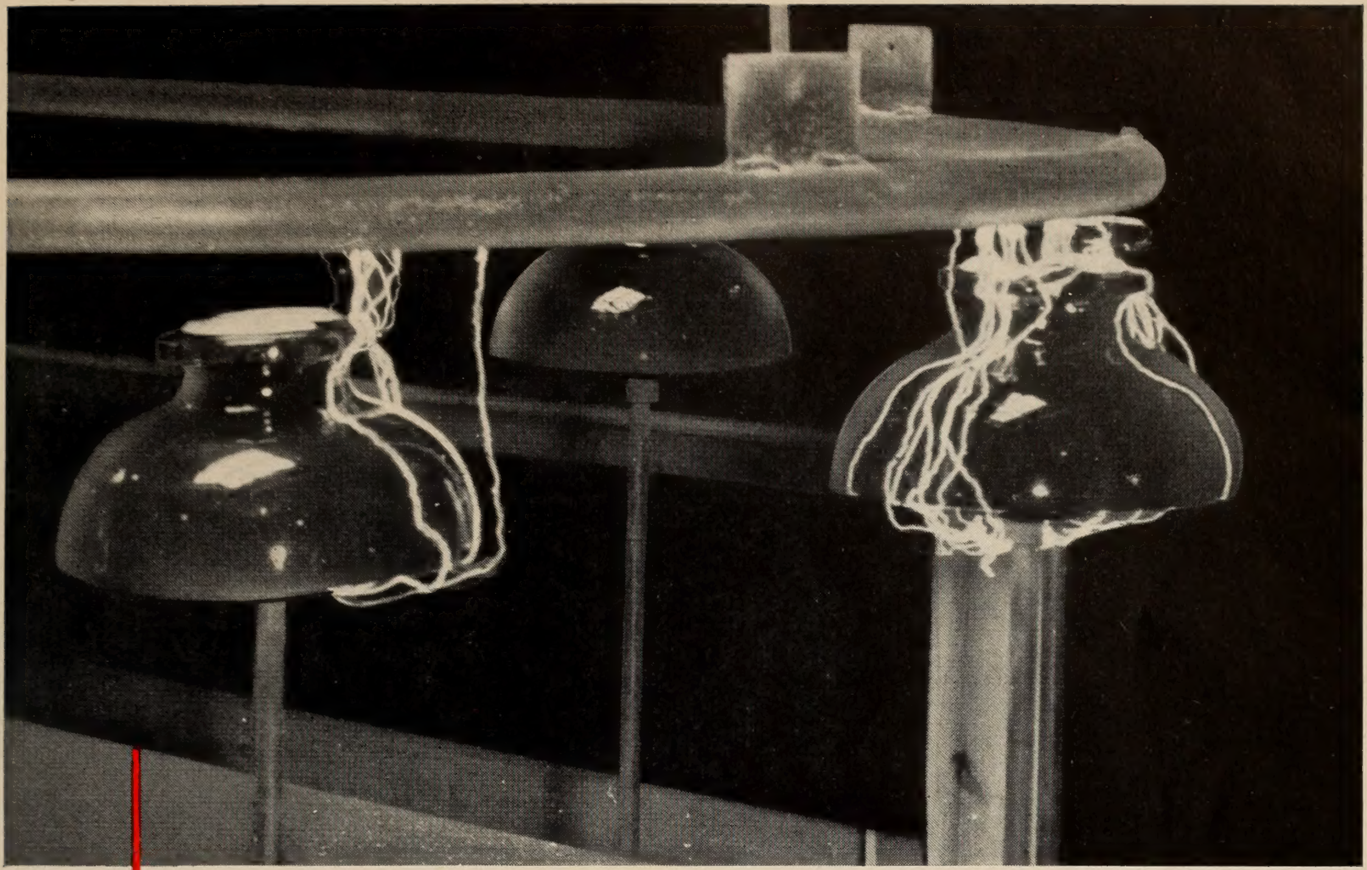
BRISTOL'S

TORONTO • MONTREAL • HAMILTON • VANCOUVER

B-6

HALIFAX	FORT WILLIAM	WINNIPEG	EDMONTON-CALGARY
A. R. WILLIAMS MACHINERY CO. LTD.	M. F. MILLS SUPPLY LIMITED	FILER-SMITH MACHINERY CO. LTD.	GORMAN'S LTD.

MEASUREMENT OF INDUSTRIAL PROGRESS



"not a single one sneaks by!"

Full flash-over and dual testing of these low voltage pin-type insulators is just a part of the rigid testing routine regularly carried out on *every single pin type insulator* produced by Canadian Porcelain.

The continuous moving belt is so designed that each insulator undergoes a ten-second high frequency, and a five-minute normal frequency, full flash-over.

Strict supervision ensures the removal of any insulator that fails to pass this exacting test — so "not a single one sneaks by."

This results in the customer receiving insulators that have been fully tested, electrically and mechanically, and represents part of producing a first class product.

CANADIAN PORCELAIN
Company Limited
HAMILTON · ONTARIO · CANADA

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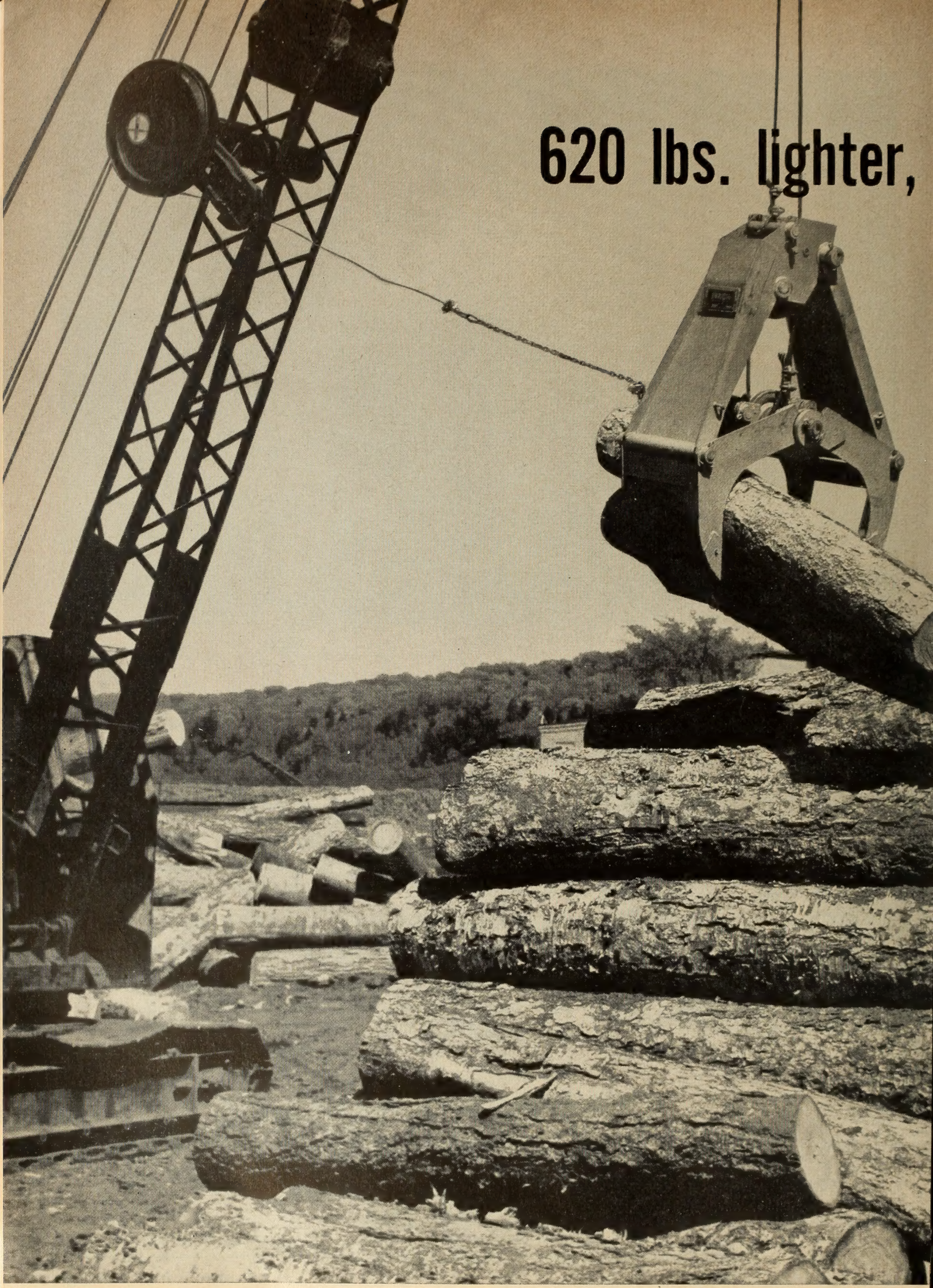

620 lbs. lighter,

more portable, and more durable . . .

Welded assembly of USS "T-1" Steel cuts grapples weight 47 per cent

It isn't the logs that wear out log grapples like these. But dropping the grapples 10, 25, or 30 feet, twice a minute, hour after hour, day after day, does wear them out. They literally destroy themselves. That's why light weight is important. And toughness. And strength.

Mack Welding Company, Duluth, Minnesota, has cut weight of grapples 620 lbs. and simultaneously *increased* durability, just by switching from mild steel to rugged USS "T-1" Steel. Here is what they say about "T-1":

"We thought we had reached the lowest possible weight when we manufactured a previous model weighing 1300 pounds. But these new grapples made from your "T-1" Steel weigh only 680 pounds—just a little over half as much. That's an important advantage for loggers who have relatively small-capacity truck-mounted cranes. No other rolled steel plate would give us such light weight in grapples capable of handling loads up to 3 tons."

"T-1" WELDS BEAUTIFULLY

"As far as fabrication is concerned, we find that "T-1" Steel welds beautifully and can be flame-cut in exactly the same way as mild steel, without distortion or any other difficulty. We're very pleased with it."

"T-1" Steel is unique. For it gives you a combination of high tensile and yield strength (105,000 psi and 90,000 psi), good high temperature strength, extreme toughness at sub-zero temperatures, good resistance to abrasion, impact, and abuse. You get all of these properties in one steel that is easy to weld.

You can use "T-1" to reduce weight . . . to lengthen service life . . . to reduce costs. Look around you. You'll find a job for it—a job that no other steel can do so well. United States Steel, Room 5142, Pittsburgh 30, Pa.

UNITED STATES STEEL CORPORATION, PITTSBURGH • COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

USS "T1" CONSTRUCTIONAL ALLOY STEEL

UNITED STATES STEEL EXPORT COMPANY
TORONTO • MONTREAL • WINNIPEG • WINDSOR
CALGARY • VANCOUVER • ST. JOHN'S, NEWFOUNDLAND

In hundreds of cases like this Canadian Vickers helps too

Compared to work in ward, laboratory, and operating room the job of heating a hospital is hardly dramatic. Yet heat is essential for a modern Canadian hospital to function at all. And the Steam Generators that supply heat to many hospitals were designed and built by Canadian Vickers.

In many other kinds of public buildings—offices, churches, libraries, and hotels—you will also find that Canadian Vickers' Steam Generators are the source of heat necessary for your comfort and efficiency. And in plants and factories across Canada, this company's steam generators are helping to make everything from canned milk to airplanes.

As builders of Pulp and Paper Machinery, Ships—and a tremendous range of equipment for the Mining, Oil, Food, Plastics, and Chemical industries—Canadian Vickers serves you in one way or another every hour of the day.

OF INTEREST TO ENGINEERS . . . is the fact that among the 14 points of definite superiority Vickers-Keeler Steam Generators offer over other units are the patented cross-over tubes. This system guarantees that if there is any water in the boiler it must flow into the front wall tubes where it is needed for steam generation.

CANADIAN VICKERS LIMITED
MONTREAL
Toronto Vancouver

MAKING THE THINGS THAT MAKE THE THINGS YOU NEED

V-56

The STRAIGHT WAY Home

The R Theta D-R Navigation Computer, produced for the RCAF, is the first of its type in the world. Completely electro-mechanical in operation, no ground or airborne transmitted information is needed. Now under evaluation by the USAF and the RAF, the R Theta, will guide the pilot the straight way home no matter where he flies.

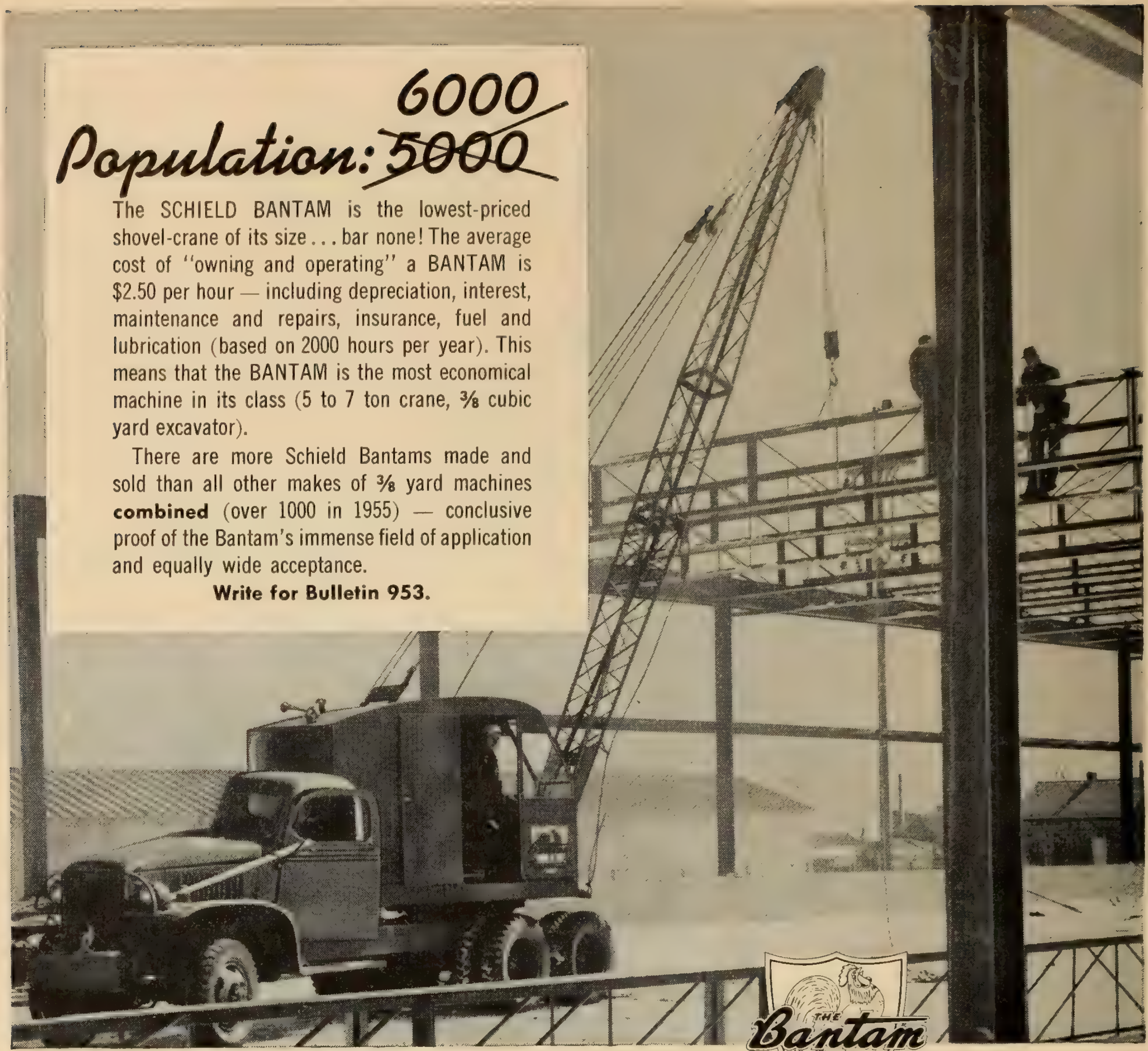
The R Theta D-R Navigation Computer

This new milestone in aviation was invented by Wing Commander J. G. Wright, RCAF. He was awarded the McKee Trans-Canada Trophy for 1954 for this contribution to Canadian aviation. The R Theta was developed and is being produced for the RCAF by PSC Applied Research Ltd.

PSC APPLIED RESEARCH LIMITED

PSC APPLIED RESEARCH LTD.

1500 O'CONNOR DRIVE
PLYMOUTH 5-3371
TORONTO 16, ONTARIO, CANADA



Population: ~~5000~~ 6000

The SCHIELD BANTAM is the lowest-priced shovel-crane of its size . . . bar none! The average cost of "owning and operating" a BANTAM is $2.50 per hour — including depreciation, interest, maintenance and repairs, insurance, fuel and lubrication (based on 2000 hours per year). This means that the BANTAM is the most economical machine in its class (5 to 7 ton crane, ⅜ cubic yard excavator).

There are more Schield Bantams made and sold than all other makes of ⅜ yard machines **combined** (over 1000 in 1955) — conclusive proof of the Bantam's immense field of application and equally wide acceptance.

Write for Bulletin 953.

THE Bantam
SCHIELD BANTAM COMPANY
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3/8 YARD SHOVEL Handles 90 yards per hour.
20", 25" or 30" TRENCH HOE — Digs 100′ of 5′ Trench per hour.
12", 16", 20" or 24" MOLE'S PAW—For really tough trenching.
5′ x 2′ BACKFILL BLADE— Fills in 350′ trench in one hour.
DRAGLINE WITH FAIRLEAD — Handles 70 yards per hour.
CLAMSHELL — Loads 80 yards per hour.
CRANE — Power-controlled lowering and raising.
29" MAGNET — Handles 20 tons of scrap per hour.
PILE DRIVER — Up to 2400 lb hammer, with leads.

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See the Bantam in action

Ask for a demonstration TODAY

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MOUNTING

CRAWLER	**5 TON CAPACITY**
SELF-PROPELLED	**6 TON CAPACITY**
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Construction Equipment Company
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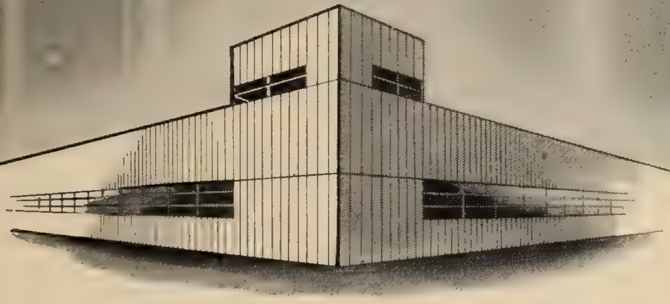
Johns-Manville
Announces

TRANSITILE*

* A NEW
ASBESTOS-CEMENT
SHEET OF IMPROVED
DESIGN FOR ROOFING
AND SIDING



- SMART, MODERN LOOK
- GREATER STRENGTH
- LIGHTER WEIGHT
- MAINTENANCE-FREE
- FIRE RETARDING
- RESISTS CORROSION

Your first impression of Johns-Manville's new Transitile will be of its modern, decorative appearance. The well-spaced corrugations lend smart structural lines making Transitile architecturally ideal for a wide variety of commercial and industrial buildings. Transitile offers many other advantages. Non-combustible, it is highly effective in retarding the spread of fire. It resists all common acid fumes, gases and climatic conditions. The design of Transitile provides greater strength with less weight than other types of asbestos-cement sheets; this speeds handling and permits widely spaced supporting members. A rich, light-reflecting gray, Transitile will never need paint to preserve it.

Before you decide on roofing and siding for any building, it will pay you to investigate Transitile. For complete data write Canadian Johns-Manville, Dept. 6186 565 Lakeshore Rd. E., Port Credit, Ont.

B 467

JOHNS-MANVILLE JM PRODUCTS Johns-Manville

Type 500 Goodman Continuous Coal Mining Machine in operation.

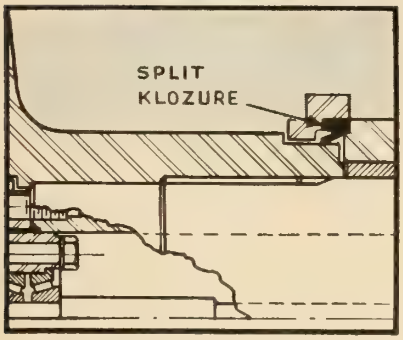
Garlock Split-KLOZURE Oil Seal—specifically designed for heavy equipment.

Goodman Mining Machines get positive bearing protection with KLOZURE* OIL SEALS!

The bearings on Goodman Mining Machines are subjected to the most severe service conditions—particularly coal dust and dampness. To provide positive protection for these costly bearings, Goodman engineers use dependable Klozure Oil Seals.

Garlock Split-Klozures, which can be installed around the shaft *without* dismantling the equipment, are used on the main bearing. Standard Model 53 Finger Spring Klozures (not illustrated) are used on the tractor roller bearings.

Let us show you how superior Klozure Oil Seals can solve your sealing problems. Just contact the Garlock office nearest you, or write for Klozure Catalog 10.



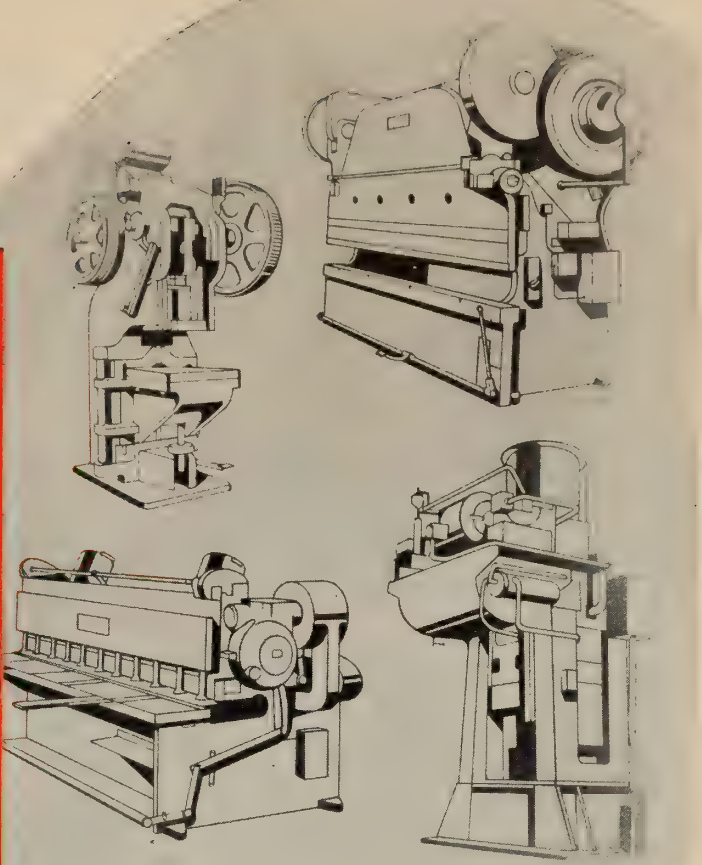
Cross section shows Garlock Split KLOZURE Seal as applied to the rotor assembly (main) bearing of Goodman's Type 401 Miner.

THE GARLOCK PACKING COMPANY OF CANADA LTD.

General Offices: Toronto, Ont.
Branch Offices: Hamilton, Montreal, Winnipeg, Calgary Vancouver

GARLOCK

*Registered Trademark



WESTEEL

BEHIND
THESE
MACHINES
A CUSTOM
SHEET
METAL
SERVICE
FOR
YOU

WESTEEL ARE SPECIALISTS IN CUSTOM SHEET METAL WORK ...CAN SAVE YOU PRODUCTION HEADACHES AND OVERHEAD

Save the capital outlay required to set up a sheet metal department. Have your sheet metal needs produced by Westeel . . . scheduled to meet your assembly line needs. The up-to-the minute facilities of Westeel's custom sheet metal departments are at your service.

From customers' drawings or blue prints, the production of parts and products to specification is an important part of our business. We have the equipment, the experience and the skilled organization to take your sheet metal production problems off your mind . . . and save you money.

Westeel is equipped to shear, stamp, form, weld, rivet, assemble and paint sheet metal and light structurals up to 3/8 inch.

Your enquiries will receive immediate attention.

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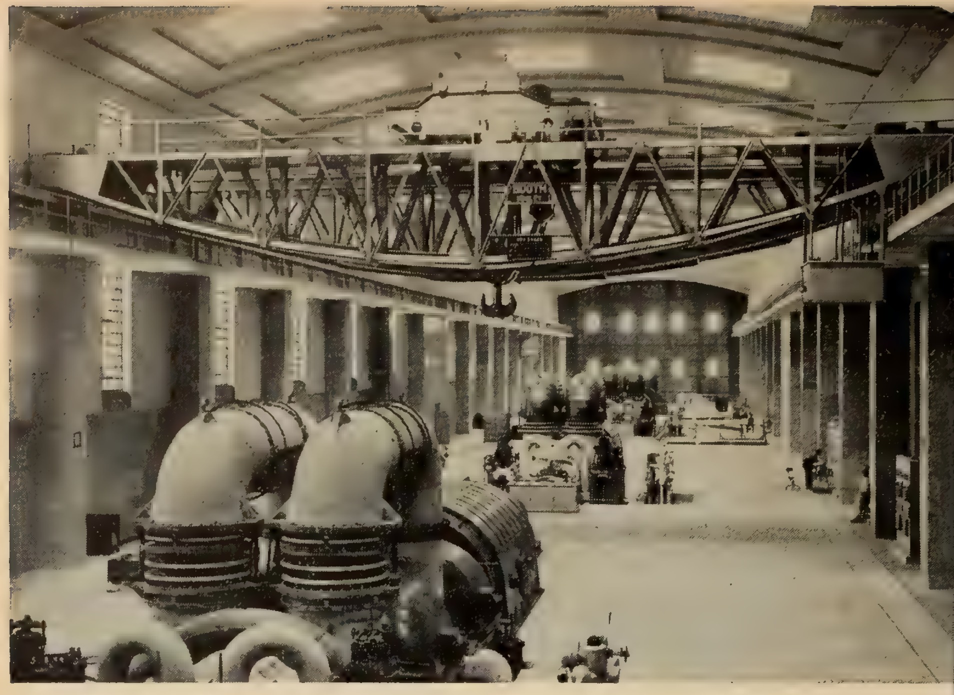

Booth 120/15 tons overhead crane at Croydon Power Station.

CRANES

BUILT TO HANDLE THE JOB OF YOUR REQUIREMENTS

The Booth Method of classifying overhead electric travelling cranes to suit service factors means that it is possible to offer a standard crane to serve almost any industrial requirement, from light duty up to heavy duty continuous process cranes for steel works. Booth installations within this range are serving industry in many parts of the world. This method effects considerable economies making possible the standardisation of components whilst retaining for the customer the advantage of being able to choose a crane to suit his individual requirements. A Booth handbook of overhead cranes is available on request.

Clyde 10 ton Electric Level Luffing Grabbing Crane at a London Gas Works.

Booth 12½ tons Iron Ore Transporter at Bidston Dock, Birkenhead.

CLYDE CRANE & BOOTH
LIMITED
200 ST. JAMES ST., WEST
MONTREAL

OUR CRANES ARE IN USE ALL OVER THE WORLD

Pouring temperatures of Nickel Cast Iron at a well-known Toronto foundry being checked by an INCO Research Engineer.

INCO RESEARCH ENGINEER ASSISTS FOUNDRY IN THE PRODUCTION OF QUALITY NICKEL CAST IRON

INCO can be of service* to you

For years INCO has put its facilities, personnel and experience at the service of industry. Above is an example of the close liaison and assistance on the part of INCO Engineers with industrial users of INCO NICKEL. The wide range of practical experience of INCO Research Engineers, plus the fund of information available to them from the thousands of records on file, provides industry with a unique form of personal service and assistance on metals.

**Information involving corrosion, fabrication, foundry problems, high and low temperature service and metals selection.*

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GOES WITH INCO NICKEL

EMBLEM OF INCO SERVICE
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DEVELOPMENT AND
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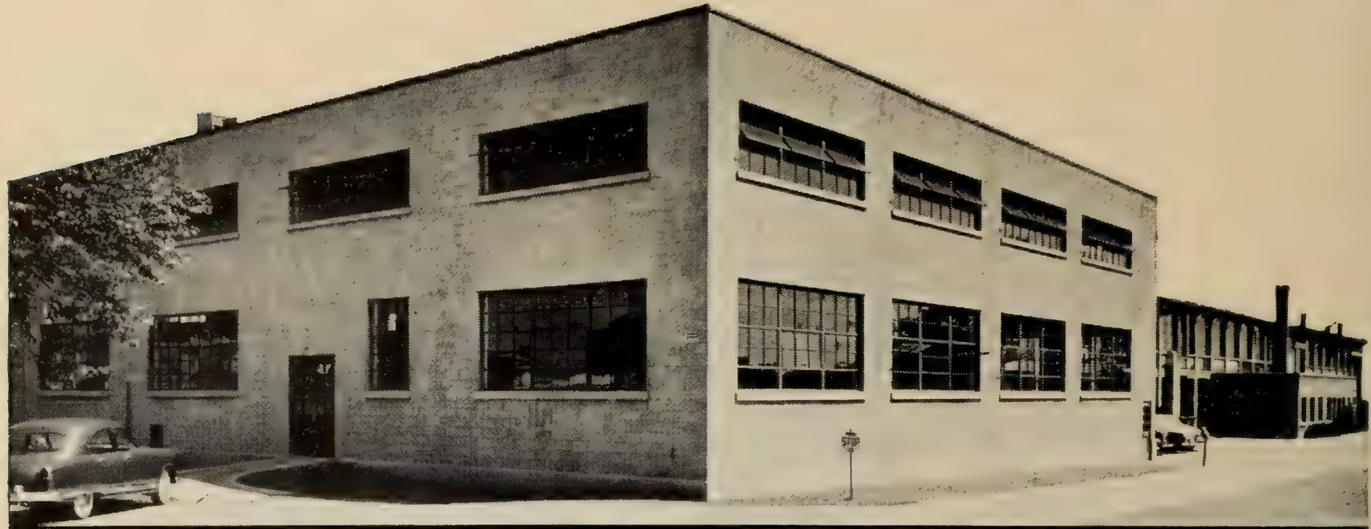
THE INTERNATIONAL NICKEL COMPANY OF CANADA, LIMITED, 25 KING ST. W., TORONTO

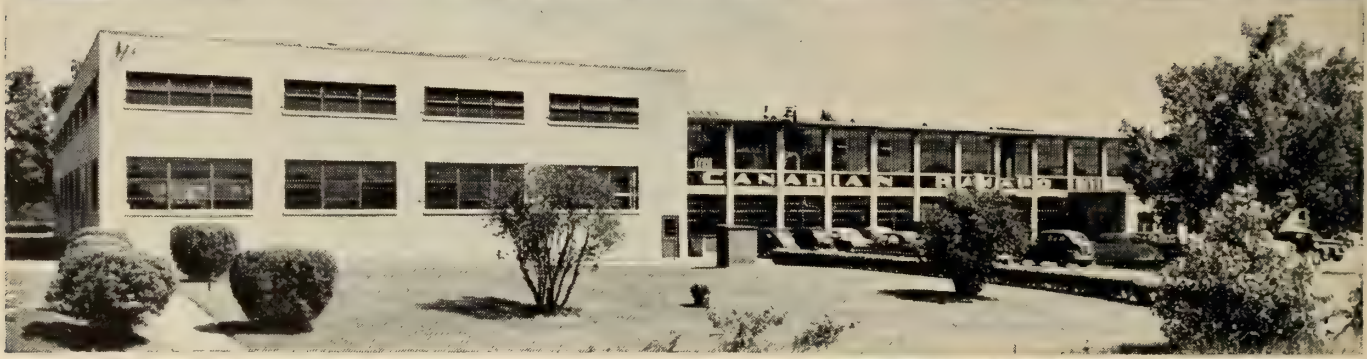
10 DRAVO *Counterflo* HEATERS INSTALLED

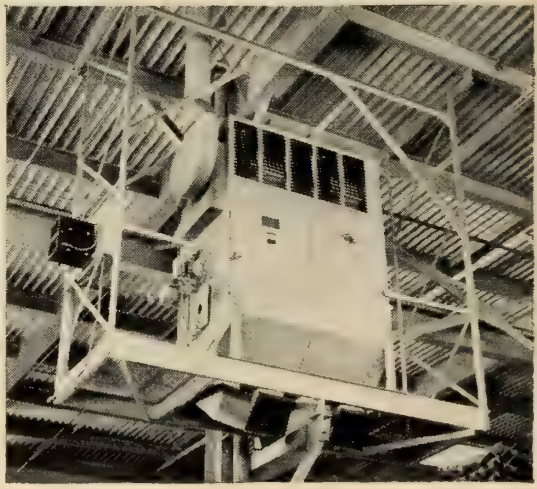
to assure maximum comfort at



DOMINION BRAKE SHOE,

CANADIAN RAMAPO DIVISION, NIAGARA FALLS, ONTARIO





Another of Canada's industrial plants beats its heating problems with Dravo "Counterflo" Heaters. Three #50, three #75 and four #100 Dravo heaters assure maximum heating comfort with minimum operating costs at the Canadian Ramapo Division of Dominion Brake Shoe at Niagara Falls, Ontario.

"Counterflos", like others in the Dravo line, the "Paraflo" and the Gas Fire Unit Heaters, have automatic temperature control and a minimum efficiency of 80%. They require no ductwork . . . can be mounted horizontally or vertically and easily moved to any location. Gas Fired Units are available in sizes from 68,000 to 2,000,000 BTU/hr and the Counterflo and Paraflo Oil Units in sizes from 200,000 to 2,000,000 BTU/hr. WRITE FOR MORE INFORMATION TO

DRAVO

HEATING DIVISION

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1405 PEEL STREET,
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57 BLOOR STREET WEST,
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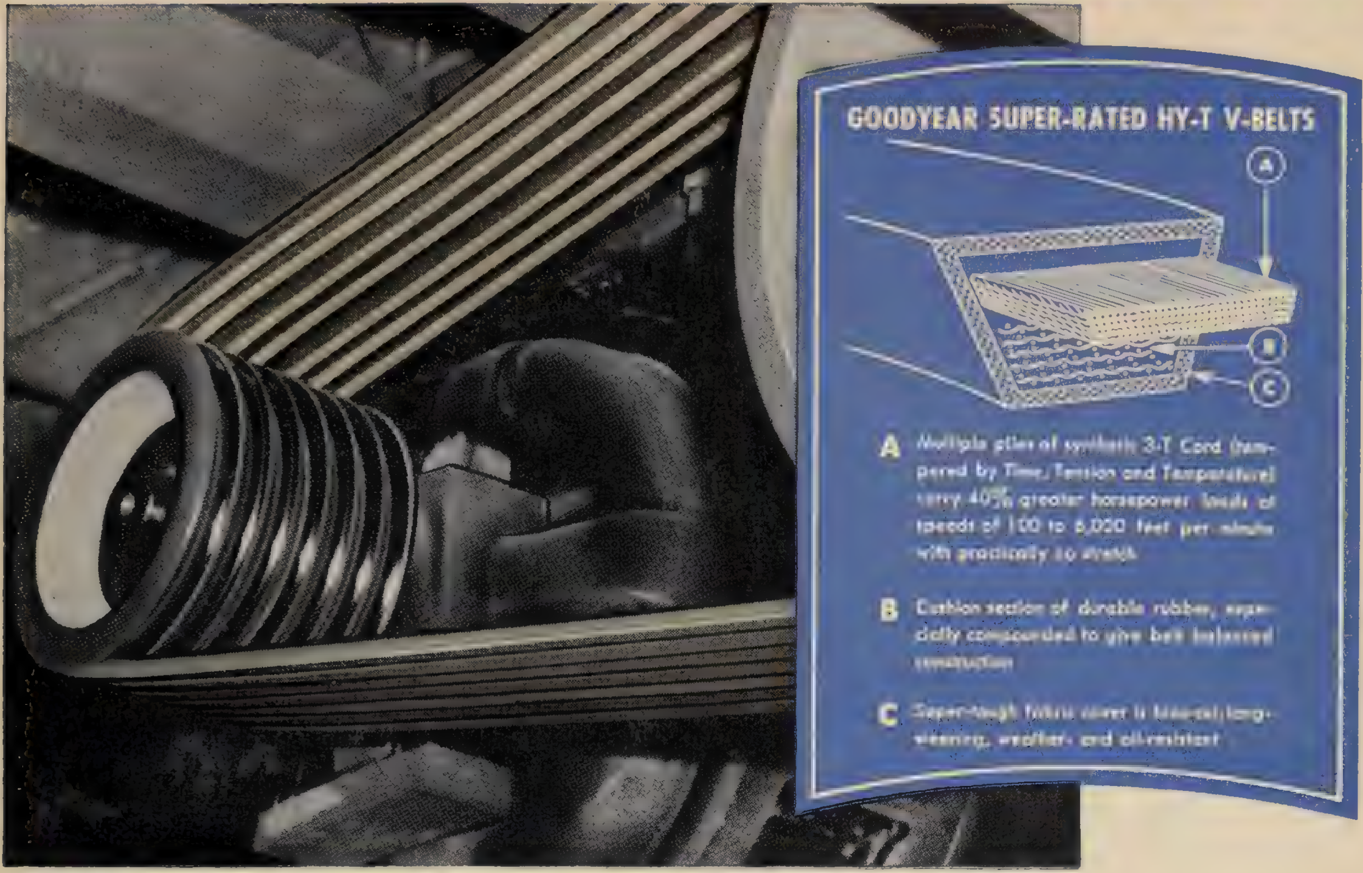
The SECRET of SUCCESS...



A Multiple plies of synthetic 3-T Cord (tempered by Time, Tension and Temperature) carry 40% greater horsepower loads at speeds of 100 to 6,000 feet per minute with practically no stretch.

B Cushion section of durable rubber, especially compounded to give belt balanced construction.

C Super-tough fabric cover is bias-cut, long-wearing, weather- and oil-resistant.

is matching!

High speeds and tough shock loads are the efficiency robbers that cause some belts to stretch, to lose their grip or break on multi V-belt drives. Goodyear found the answer to this problem.

The secret of success is matched sets of HY-T V-BELTS. These sets are matched for length, strength, weight and balance. Goodyear matching assures equal distribution of work load for uniform efficiency and exceptionally long service life.

Goodyear HY-T V-BELTS are sinewed with Triple Tempered (3-T) Cords to provide 40% higher H.P. ratings—7 belts can do the work of 10—or the same number of belts will substantially increase belt service life. Goodyear HY-T V-Belts have oil resisting covers, are mildew inhibited and can be supplied static-conducting.

Each Goodyear Branch has the necessary matching equipment to supply the "sets" to harness your belt killer drives.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS ENGINEERED FOR THE JOB

For complete information write or call your nearest Goodyear office at—Moncton, St. John, Quebec City, Montreal, Toronto, London, Windsor, Winnipeg, Regina, Saskatoon, Calgary, Edmonton, Vancouver, or Head Office, New Toronto.

Located in a very busy district and adjoining the C.N.R.'s main offices which house their teletype nerve centre, the new skyscraper has to be erected with a minimum of noise; hence the extensive use of field welding of beam and column joints and much of the vertical wind bracing by Dominion Bridge Company Limited, responsible for the steelwork.

L.A.'s ATOM ARC Electrodes used for C.N.R.'s new $20 million Queen Elizabeth Hotel, Montreal

The joining of the lighter beams to the heavier columns of this structure, without preheating, called for the use of low-hydrogen electrodes.

After erection work had started, L.A.'s *ATOM ARC* Electrodes were introduced on the job and met with the welders' approval to such an extent that they were adopted for structural welds.

Behind the welders' enthusiasm for *ATOM ARC* on this structural steel work, or on any other field welding, are cold facts no steel fabricator should overlook. Here are some of the benefits offered by *ATOM ARC* Electrodes:

SPEED—more pounds of metal deposited per hour.

GREATER DEPOSITION EFFICIENCY—more pounds of weld metal per electrode.

NO MOISTURE PICK-UP—under normal conditions, *ATOM ARC* Electrodes effectively resist moisture pick-up for 10 days after container is opened.

HIGHEST PHYSICAL PROPERTIES—weld metal is X-ray-sound and has better impact resistance than ordinary low-hydrogen electrodes. No starting porosity.

EASIER TO USE IN ALL POSITIONS—easy-to-handle arc greatly reduces welder fatigue.

ATOM ARC Electrodes are protected from moisture and mechanical damage by strong, convenient, hermetically sealed metal containers.

Contact your nearest L.A. Branch office for complete details.

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TRIED on the Shading Machine!
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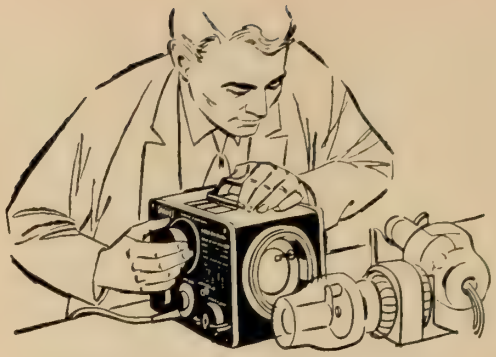

Checking a rotating anode X-ray tube for acceleration and smooth operation in a matter of minutes, with a Dawe Stroboflash.

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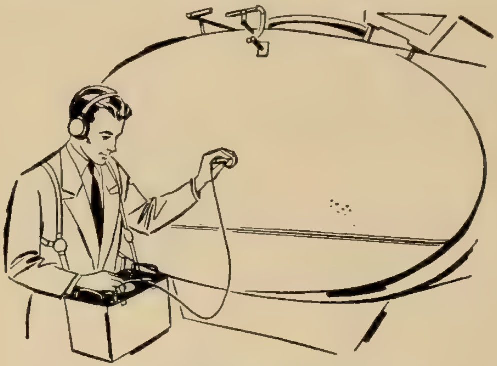
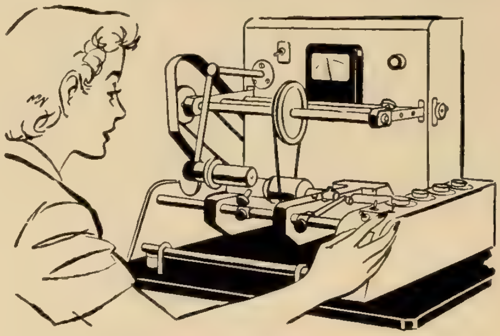
Type No. 1200 Series. Measures high-speed operations and observes fast-moving objects in apparent slow motion. Direct-reading range 150-18,000 r.p.m.



Measuring the thickness of the dished-end of an acid tanker during overhaul. Inspection by mechanical means is practically impossible.

ULTRASONIC THICKNESS GAUGES

Measure the thickness of materials where only one surface is accessible. Ranges: (Type 1101) 0.060 in. to 12.0 in. of steel.
(Type 1101-1) 0.020 in. to 4.0 in. of steel.



Balancing the armatures of electric hand-drills.

DYNAMIC BALANCING MACHINES

Type 1250. For rotors weighing 1 oz. to 10 lbs.

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BETHLEHEM STEEL

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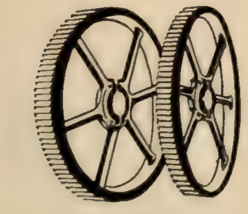

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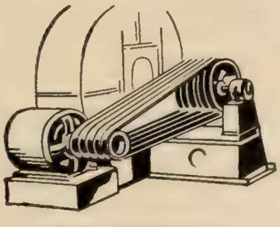

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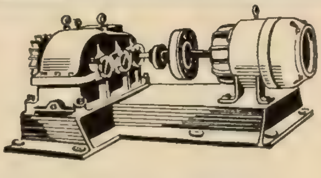

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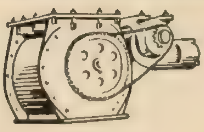

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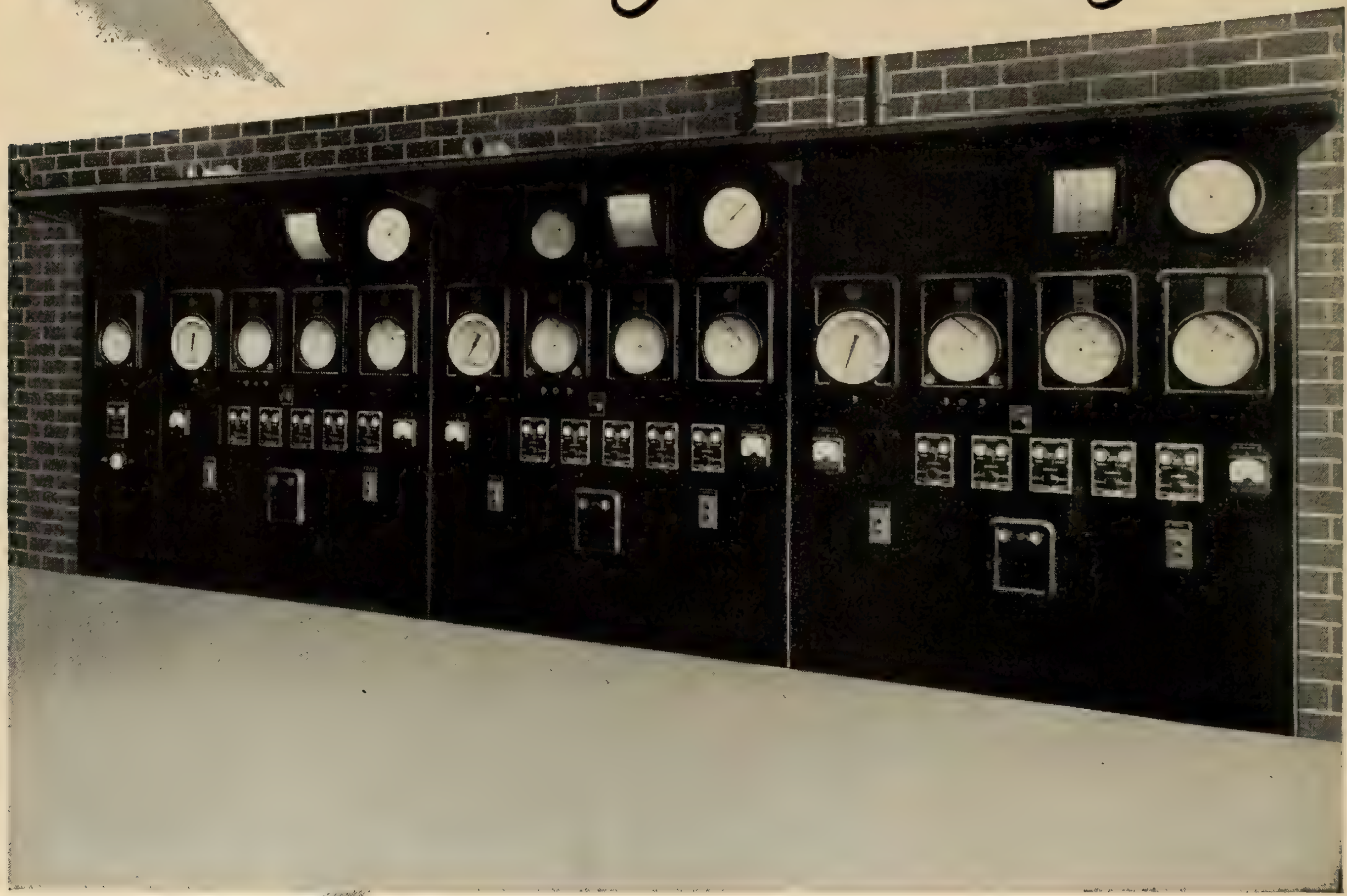

Hospitals across Canada stand ready 24 hours a day to minister to our needs.

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Bailey Co-ordinated Combustion Control and Multi-Element Feed Water Control are sure to be found in most hospital power plants.

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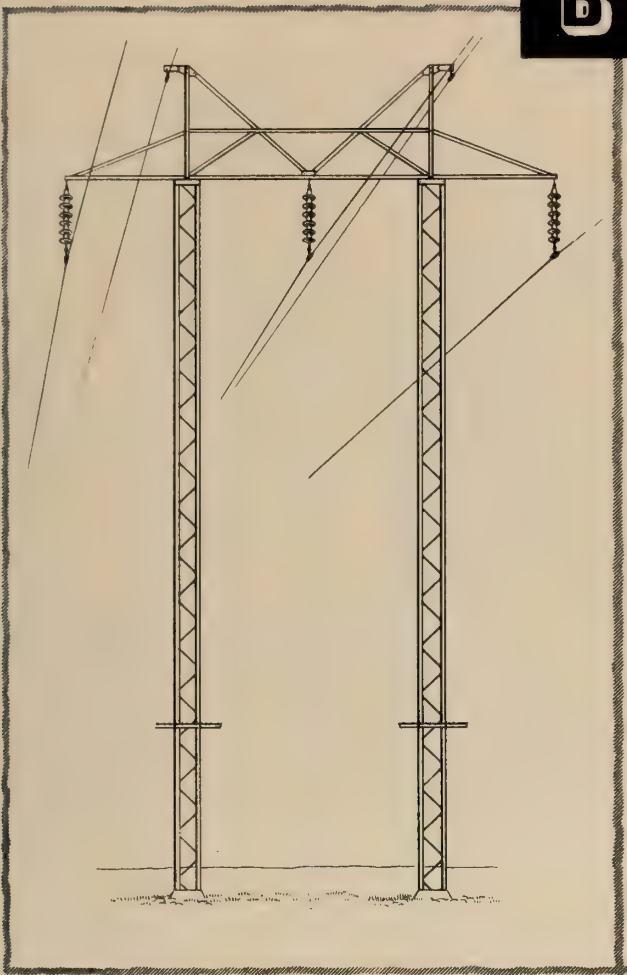
With Branches and Representatives in many countries, and our unrivalled experience, we can undertake work of this kind—anywhere!

A list of publications describing our full range of activities is available on request.

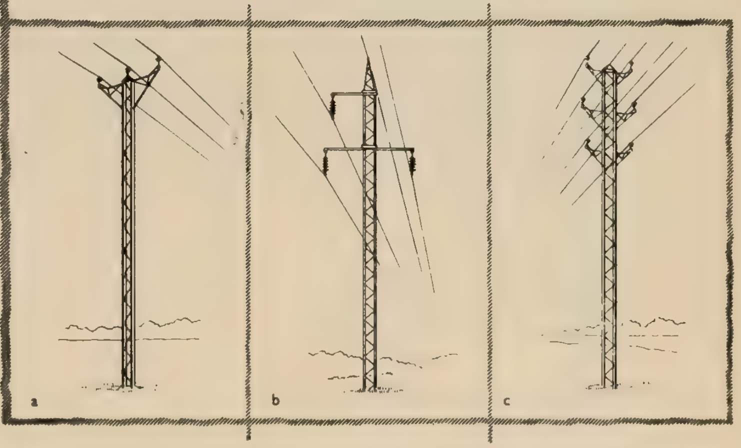


above: 66kV H-type Structure

right: (a) 11kV Intermediate Pole

(b) 66kV Pole

(c) 11kV Double-Circuit Pole



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***Head Office:* 30 LEICESTER SQUARE, LONDON, W.C.2,**
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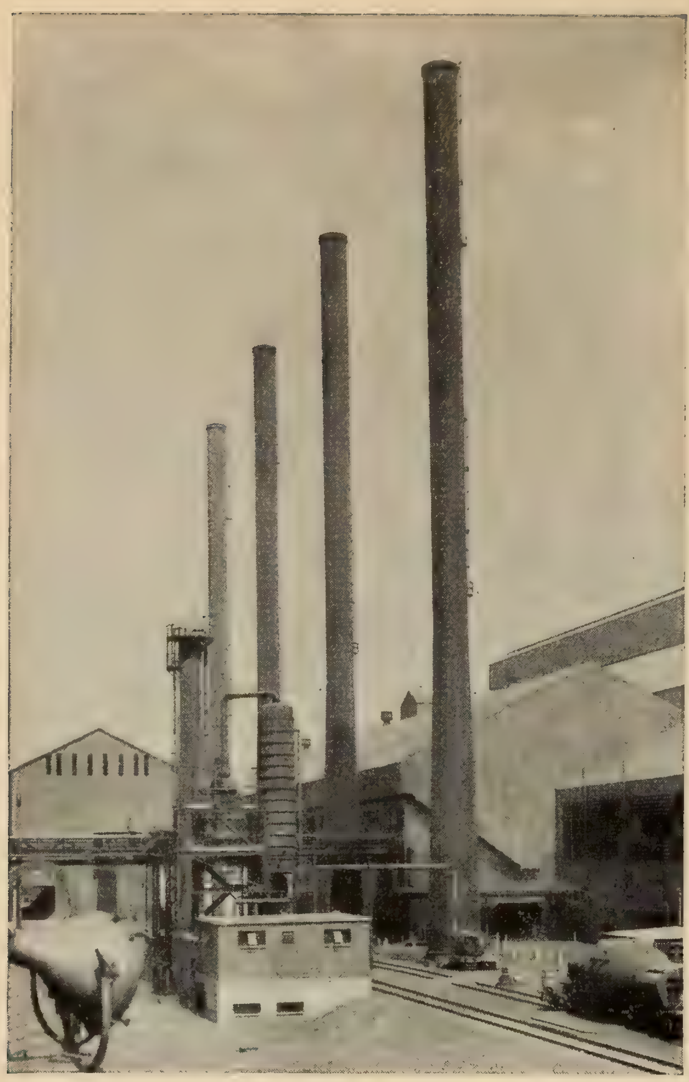

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Skilfully fabricated and erected, these four, self-supporting steel stacks — measuring 225 ft. in height — were installed at the Hamilton Works Plant of the Steel Co. of Canada Ltd. by Horton Steel. Anchored securely to a substantial sub-structure in order to resist a wind movement of gale proportions, these stacks were built in plate thicknesses ranging from $\frac{5}{16}$ in. to ½ in.

Specialized steel plate work like this offers no obstacles to Horton Steel design, fabrication and erection departments. Each structure is especially fabricated . . . and engineered to requirements.

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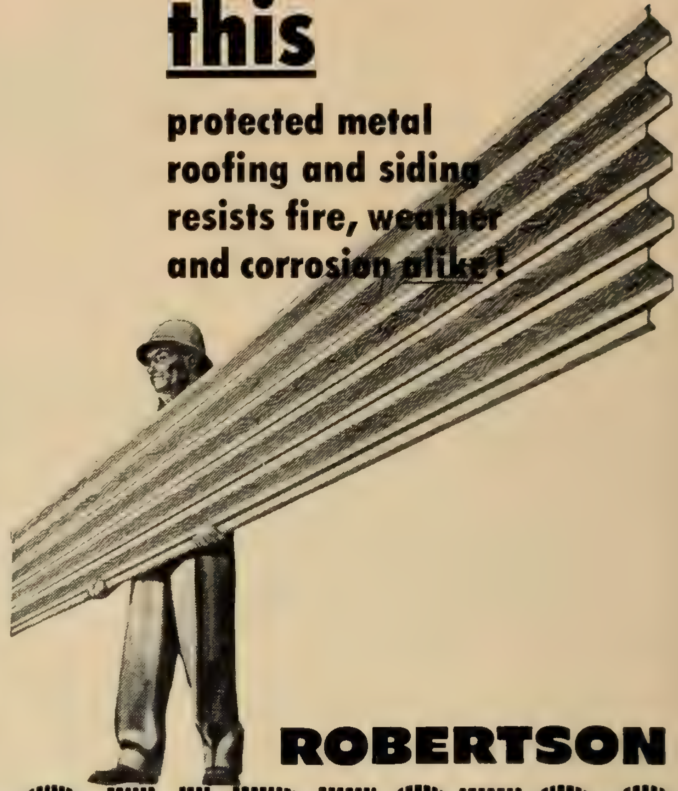
protected metal roofing and siding resists fire, weather and corrosion alike!



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The result of over 40 years research, GALBESTOS has the highest resistance to corrosion and weather of any protected steel siding or roofing you can specify. It is an impregnable bond of steel, zinc and asbestos felt plus an outer waterproof coating. It is economical, both in its initial cost and in the future since it requires no maintenance, no painting and is corrosion-resistant.

FREE DESCRIPTIVE LITERATURE IS AVAILABLE ON **GALBESTOS**

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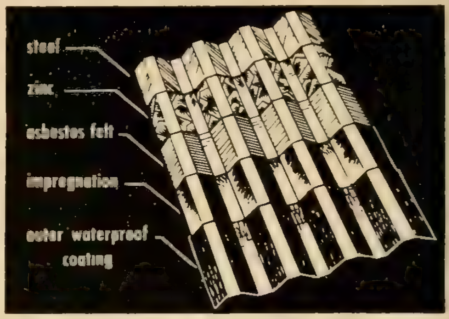

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Pipeline to Edmonton

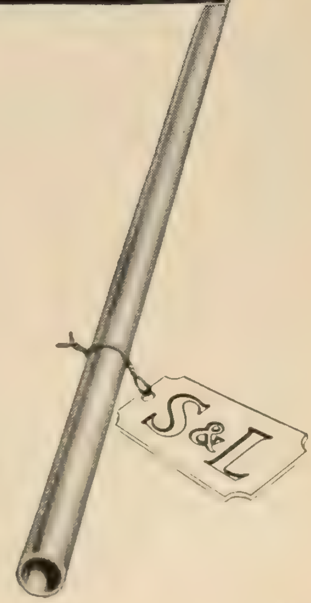
More than seventy percent of all pipelines carrying gas to the city of Edmonton is constructed of Stewarts and Lloyds' pipe.

Best known of these pipelines is the *Viking-Kinsella*. Stewarts and Lloyds' seamless pipe accounts for most of the three hundred mile length.

Two others, the *Leduc* and the *Fairydell-Bon Accord and Fort Saskatchewan* lines, total 56 miles of pipe —all Stewarts and Lloyds'.

The picture above shows the crossing of a coulee during the building of the most recent pipeline, *Bonnie Glen*. It consists of 42 miles of Stewarts and Lloyds' pipe and was completed last year.

Together, these pipelines can meet a potential demand of 271 million cubic feet per day.



STEWARTS AND LLOYDS

MANUFACTURERS OF STEEL PIPE FOR EVERY USE

STEWARTS AND LLOYDS OF CANADA LIMITED TORONTO • CALGARY

SPEED STEEL ERECTION...

with STELCO HIGH-STRENGTH BOLTS

Photo by Crawley Films

KENT-ALBERT BUILDING, Ottawa.
Architects and Engineers: Burgess and MacLean, Ottawa.
Structural Steel: Dominion Structural Steel Ltd., Montreal.

Stelco High-Strength Bolts were used in erecting this office building of 9 storeys and 2 penthouses. 1000 tons of structural steel — Erection time, 40 working days.

ECONOMY · SPEED · STRENGTH · SAFETY · ADAPTABILITY — these are the benefits to be gained by using High-Strength Bolts for joining structural steel members.

More and more erectors are using this accepted fastening technique — pioneered in Canada by Stelco — to speed steel erection and cut costs.

Only a two-man crew is required; one to hold the bolt head with a spanner and the other to tighten the nut with an impact wrench. In a matter of seconds the connection is completed. Stelco High-Strength Bolts are used with hardened washers under both the head and the nut, and when torqued to proper values remain tight indefinitely.

Stelco High-Strength Bolts meet the requirements of A.S.T.M. Specification A-325, as required by C.S.A. Specification S16-1954. A wide range of sizes is stocked, assuring prompt shipment of your orders. Additional information is contained in Stelco's booklet "High-Strength Bolts for Structural Steel Joints," available from your nearest Stelco Sales Office.

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THE STEEL COMPANY OF CANADA, LIMITED

Manufacturers of Fasteners since 1866

Executive Offices: Hamilton - Montreal

Sales Offices: Halifax, Saint John, Montreal, Ottawa, Toronto, Hamilton, London, Windsor, Winnipeg, Edmonton, Vancouver. J. C. Pratt & Co. Limited, St. John's, Newfoundland.

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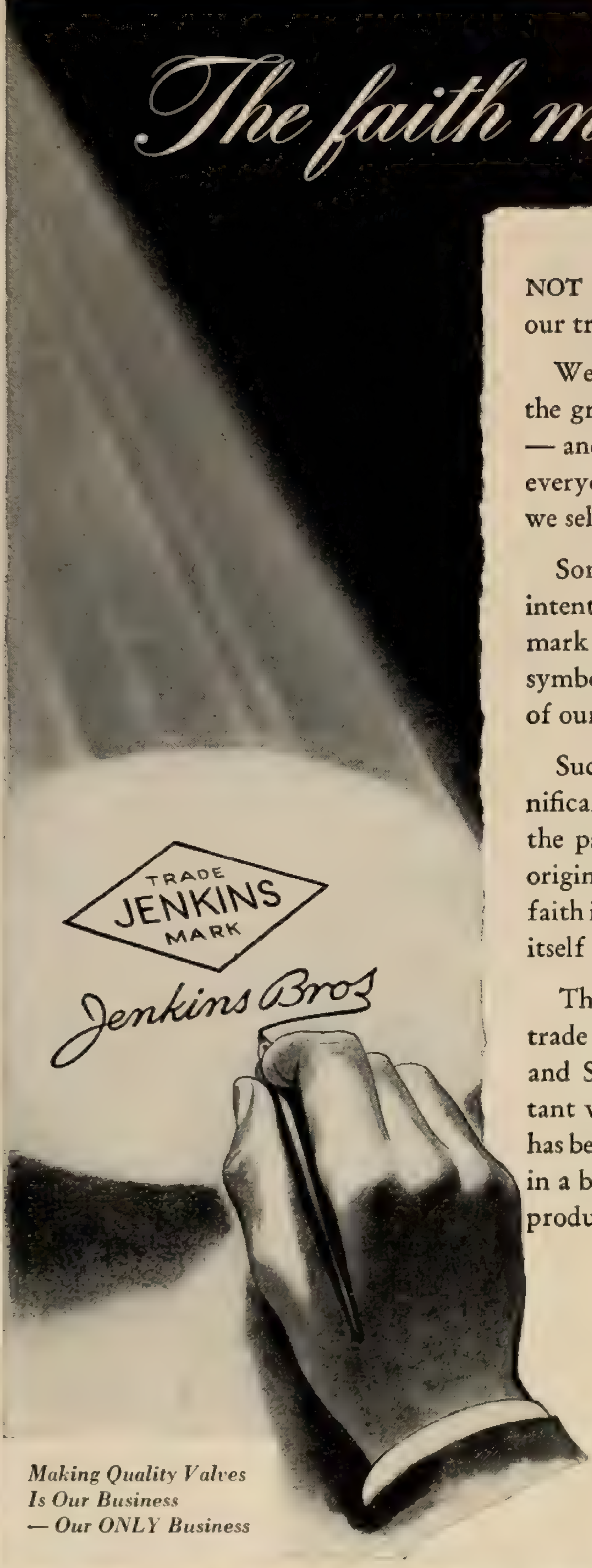

The faith men live by

NOT A DAY GOES BY that we don't put our trust in others, in countless little ways.

We trust the policeman to keep the peace, the grocer to give us good meat and bread — and we trust, in measure, the honesty of everyone whose wares we buy, or to whom we sell our own.

Sometimes in evidence of our good intent, we sign our name or make our mark — and this mark becomes a visible symbol of our earnestness to merit the trust of our fellow man.

Such a mark does not attain its full significance as the ink is dry, but rather with the passage of years. As time goes by the original trust that engendered it ripens into faith in the signer's integrity, and that faith itself becomes an institution.

That is why Jenkins Bros. consider their trade mark — the Jenkins Bros. Diamond and Signature — among the most important virtues of a Jenkins Valve. This mark has become a symbol of justified faith placed in a body of honorable men making honest products, since 1864.

Making Quality Valves
Is Our Business
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Sold Through Leading Industrial Distributors

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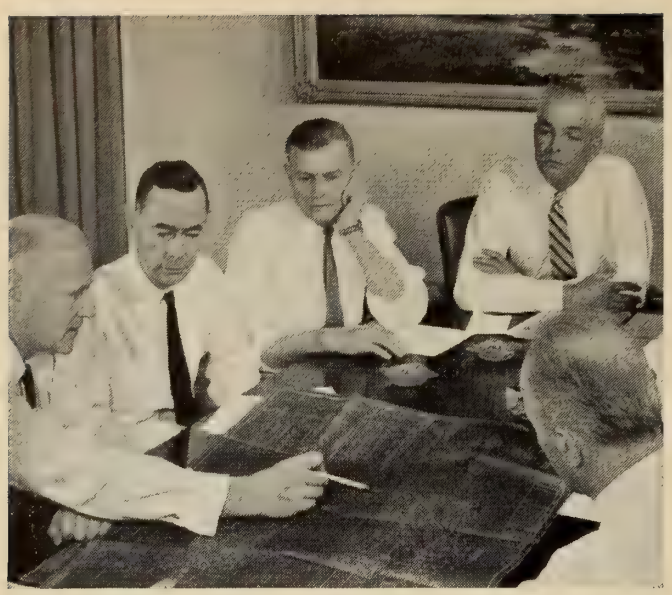


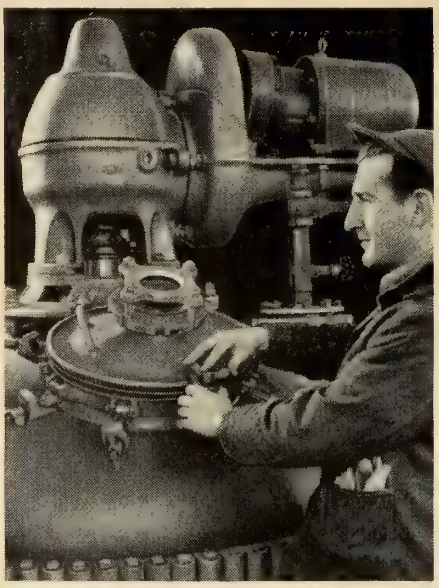
ENGINEERING. Permutit engineers work with your staff or your consulting engineers to design all or any part of your water conditioning system.

EQUIPMENT. Permutit supplies complete equipment. Critical parts such as valves, chemical feeders and controls are designed and made by Permutit.

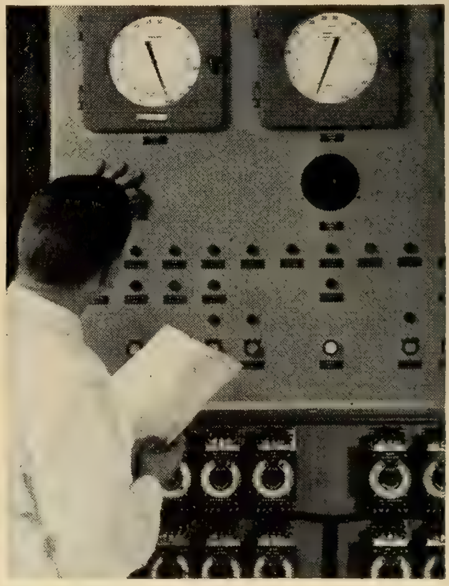
How Permutit® Solves a Water Problem

- **Water** is faced with using lower grade water. Results: possible boiler scale, turbine deposits, corrosion of pumps and piping . . . also stains, blisters and other problems in plating, rinsing, dyeing and chemical processing.
- **For expert answers,** more and more management men and their consultants are buying the complete service offered by leading water-conditioning firms. Here's how Permutit (rhymes with "compute it"), a pioneer and largest in the field, tackles a water problem:
- **Water analysis,** study of the problem and past experience provide data on possible methods of treatment. The process offering the best balance of initial and operating cost vs desired quality of treated water is selected.
- **Complete proposal** by Permutit engineers covers type, size and capacity of equipment, price, any special engineering services and performance guarantees.
- **Manufacturing** – After the proposal is accepted, Permutit designs the entire project, schedules assembly and shipping. Critical parts, ion exchange resins, control panels are all made in Permutit plants. (No other U. S. firm makes all these components.)
- **Test runs** – Where required, Permutit checks the installation, supervises start-up and initial operation, trains permanent operating personnel.
- **For further information** look up the Permutit office in your city or write to The Permutit Company, Dept. EJ-1, 5500 Royalmount Ave., Montreal 9, Que.

WATER ANALYSIS. Permutit's modern water-analysis laboratory tests over 1200 samples a month!



ION EXCHANGE RESINS. Permutit makes its own ion exchange resins, natural and synthetic zeolites.



AUTOMATIC CONTROLS to ensure optimum results are designed, assembled, wired and tested by Permutit.

HIGHLIGHTS ON TRULY FINE MAGNET WIRE

Magnet Wire insulation must meet the most exacting standards. No matter whether it be glass, cotton, paper, textile, or the ever-popular Formel—the covering must be compact, smooth and unbroken. The surface as nearly perfect as human skill can make it.

That is why, at Phillips, the greatest possible care goes into every phase of Magnet Wire manufacture. To maintain these high standards, fully-trained technicians, working with the newest equipment, produce a quality controlled product.

But that is not all, for the basic secret of Phillips Magnet Wire lies in the copper wire itself. The pure, electrolytic copper is rolled, drawn, and processed until a high surface finish is obtained. And the dead soft quality of the copper, free from springiness, makes Phillips wire a wanted product.

These are the reasons why Phillips Magnet Wires rate with the finest wires made anywhere. Bare, shaped, or insulated, your best buy is Phillips.

Phillips Electrical Company Limited. The Canadian Affiliate of the B.I.C.C. Group. Head Office—Brockville, Ontario. Sales Offices—Montreal, Ottawa, Toronto, Hamilton, Winnipeg, Regina, Edmonton, Vancouver.

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Phillips

WIRES & CABLES

Phillips Shaped Magnet Wire offers . . .

six big advantages

With a battery of *new magnet wire machines* of the latest and most improved design, just installed; and using a *specially treated* copper conductor; Phillips now offer *quick delivery* of a superb product.

1. Soft Temper—The new annealing furnace gives an extra soft temper to the copper, making it easy to handle and wind.

2. High Surface Finish—Phillips copper has always been noted for its high finish. Now an additional process adds a special smoothness. (Good finish is essential for an insulation base.)

3. Uniformly compacted Insulation—The newly installed Formel, and paper insulating machines employ a refined technique to apply a smooth compact insulation to the wire.

4. Secure Source of Supply—Phillips greatly increased manufacturing capacity assures the reliability of your source of supply.

5. Fast Delivery—Additional storage space, reserve stocks and augmented production provide for speedy delivery of all orders.

6. Reliability—For years the quality of Phillips Magnet Wire has been a by-word in the trade. Sixty-five years of experience and reputation stand back of this product.

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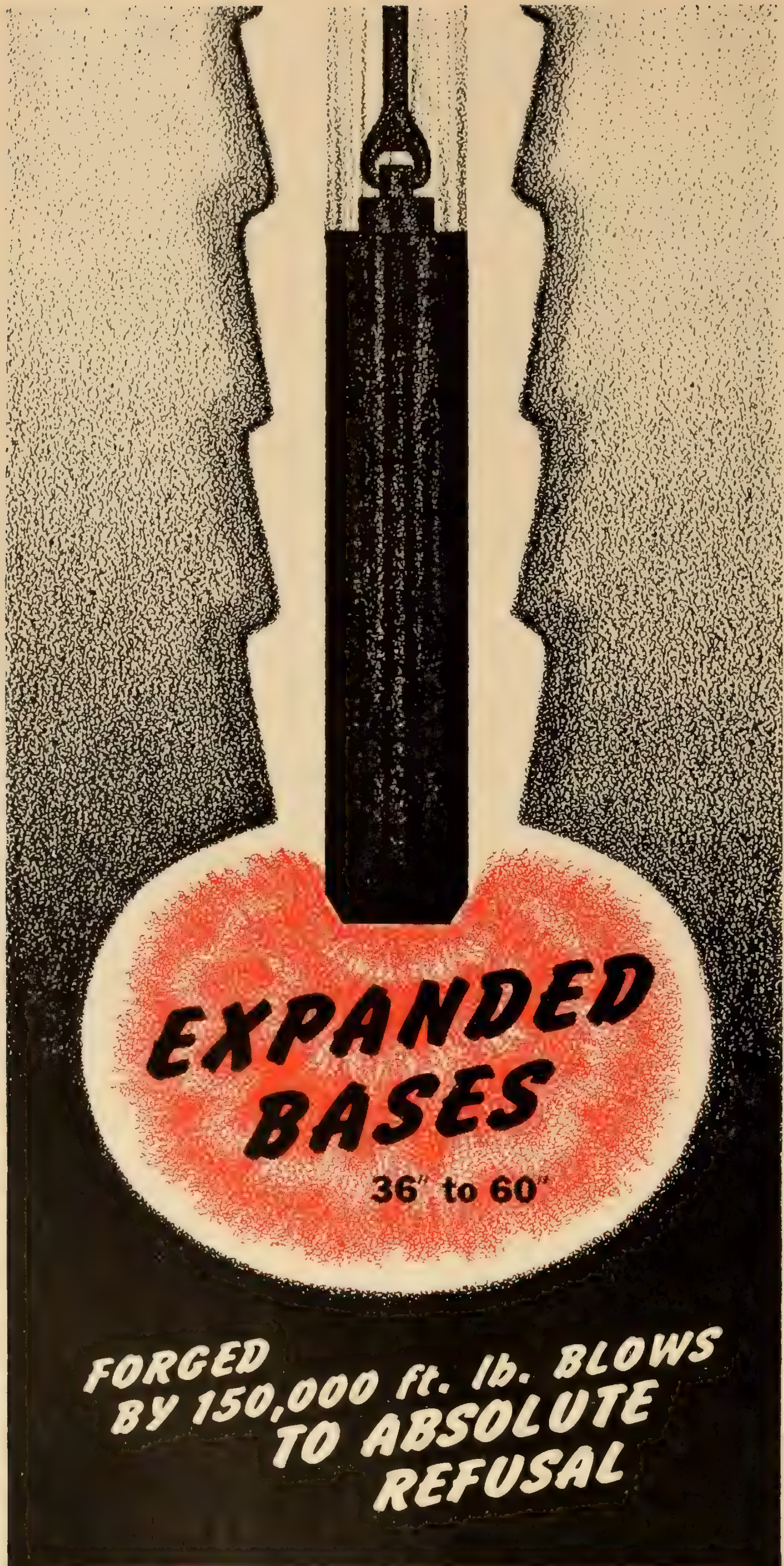
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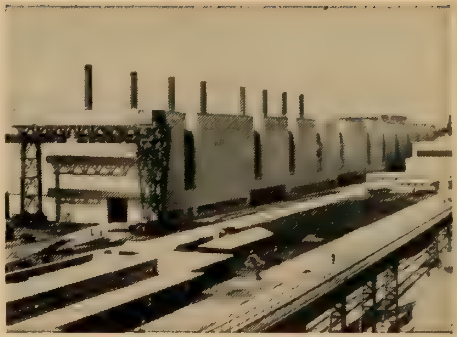

FRANKI FACTS

The following data has been made available by The Franki Compressed Pile Co. Ltd. of London, England, one of 31 companies, in 36 countries throughout the world, in the Franki organization.

Client: The Steel Company of Wales Ltd., Abbey Works, Port Talbot, Glamorgan.

Consulting Engineers: W. S. Atkins & Partners, 158 Victoria St., London, S.W.1, and 199 Bay St., Toronto, Ont.

Type of Structure: New Steel Works.

Number and Length of Piles: 32,700 caisson piles, varying between 25′ and 50′.

Working load on each: 60 tons and 90 tons.

Soil Conditions: From joint paper of W. S. Atkins & Partners and the General Contractors read before the Institution of Civil Engineers in 1950. " . . . a layer of peat up to 15′0″ in thickness under nearly the whole site. Above the peat were layers of soft clays, sand and gravels, whilst below it were mixtures of harder clays, gravels and boulders. Solid rock of mud stone or sandstone was reached at depths between 50′0″ and 70′0″ below ground level."

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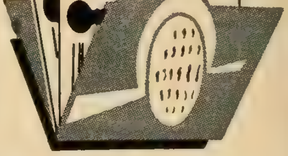

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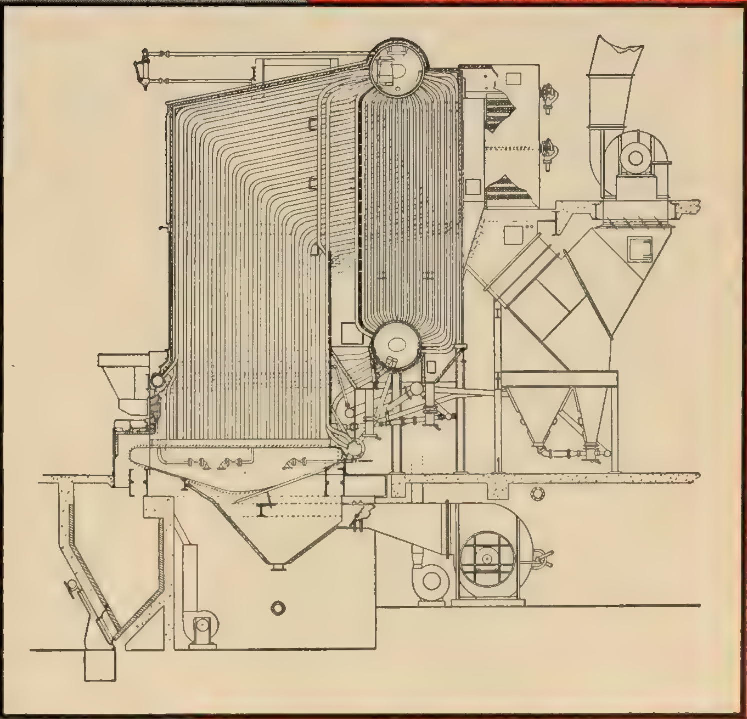

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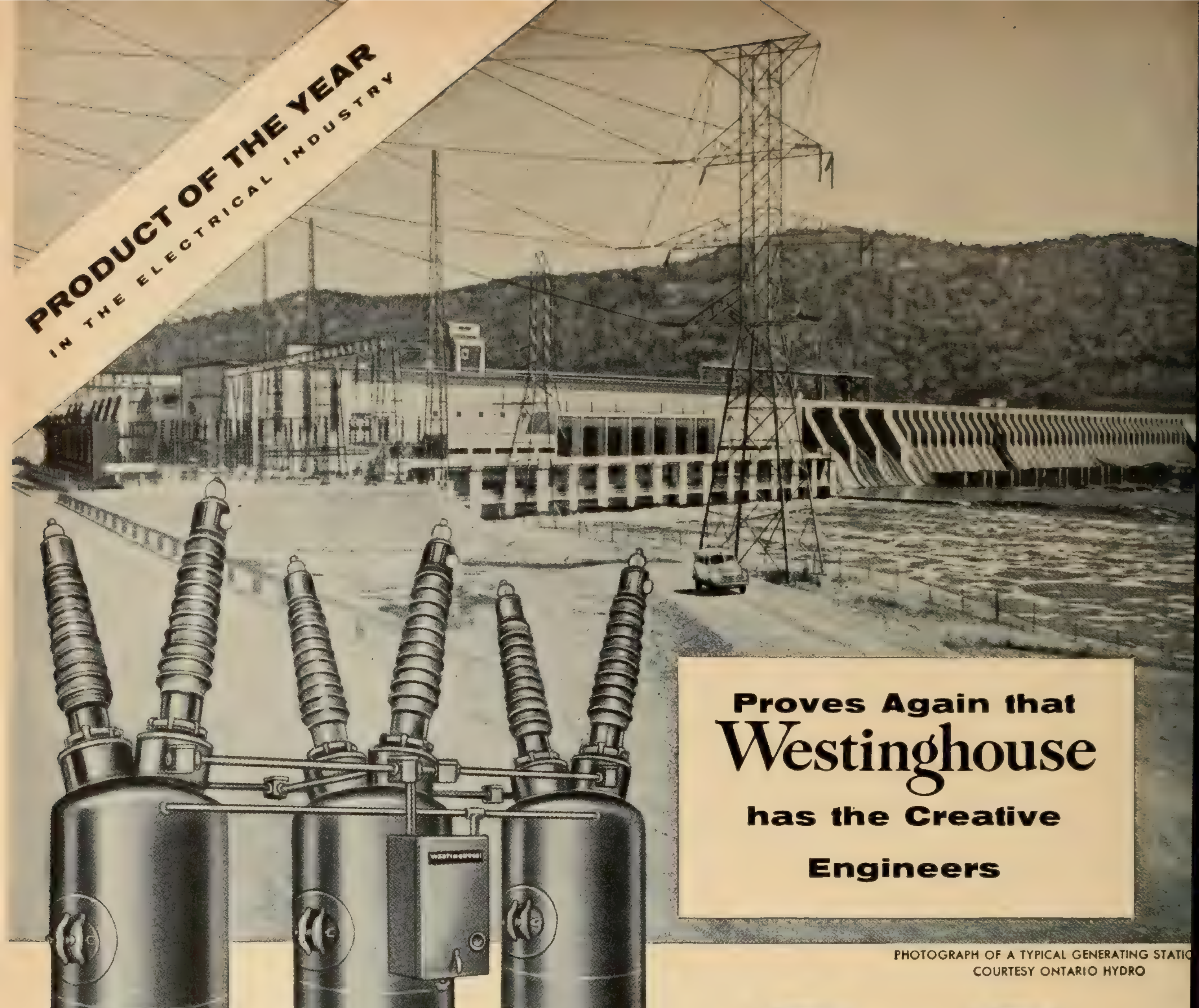

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The Selection of Boilers and their Auxiliaries for Heating and Industrial Use

A. M. Bain, M.E.I.C.
Dominion Bridge Company Limited,
Montreal, Que.

This paper describes the principal considerations governing the choice of boilers and their auxiliaries. It is directed at the layman rather than the expert and may be of assistance to a prospective purchaser in his selection of the complex equipment of his boiler plant. The paper has been recommended by the Canadian Boiler Society (of which the author's company is a member) as being an unbiased treatment of the subject.

It has been found necessary in the preparation of this paper to limit its scope in order to keep it to a manageable length. For this reason, boilers in the following categories are touched on briefly, if at all.

(1) *Electric Power Plant Boilers.*—Because of their usually large capacity, high pressure, etc., they could be the subject of a separate paper, even as general as this one.

(2) *Waste Heat Boilers.*—Utilizing hot waste gases from many different industrial processes, as well as from internal combustion engines.

(3) *Oil Refinery Boilers.*—Burning excess combustible products from the refining process.

(4) *Boilers* burning other waste products, such as bark, wood shavings, sawdust, sugar cane (bagasse).

(5) *Recovery Boilers.*—Utilized widely in the wood pulp industry, to reclaim process chemicals by burning waste from liquors and, at the same time, generating large quantities of steam.

(6) *Incinerator Boilers.* — A highly specialized type burning garbage and other refuse.

(7) *Forced Circulation Boilers.* —Formerly used principally where space was at a premium and for waste-heat applications, but now extending also into the electric power plant field.

(8) *Electric Boilers.* — Used where surplus electric power exists, or where other fuels are not economically available.

We are left, therefore, with the subject of industrial boilers and heating boilers of the more or less standard varieties, fired by liquid, gaseous or solid fuels.

Definitions

Before discussing the factors affecting the selection of boilers and their auxiliaries, it seems advisable to establish the definitions of a few of the terms commonly used in the boiler trade.

Boiler.—To most people, a boiler is a device in or under which one lights a fire using some kind of fuel to produce steam under pressure in some kind of container. This definition is over-simplified, since many boilers used for heating purposes do not deliver steam but produce hot water for direct distribution to radiators. On the other hand, the waste-heat boiler has no fire in or under it. It is one of the inconsistencies of our language that a steam-producing boiler, in which boiling takes place, is now generally called a steam generator, while the hot water boiler, where boiling is not supposed to occur, is still called a boiler.

Working Pressure. — The pressure at which the boiler delivers steam or water to a header or line; measured in Canada in lb. per sq. inch gauge (p.s.i.g.).

Design Pressure.—The pressure for which the boiler is designed. This is usually a few pounds above the working pressure so that safety valves can also be set above it. Some users provide a substantial margin of design over working pressure to provide for the "rating down" which may some day be necessary due to wear or old age.

Heating Surface.—The surface area (usually expressed in square feet) of the hot gas side of tubes, headers, etc., exposed to the hot gases. An inconsistency arises here which causes considerable confusion in the minds of those unfamiliar with trade practice. In the fire-tube boiler field, manufacturers for many years have been selling boilers whose catalogue description is based on the surface area of tubes on the water side—that is, the outside. This means that one set of areas is used in catalogues, etc., while another set, about 5 per cent smaller, is used by the designer for heat-transfer calculations and the determination of safety valve sizes to meet the safety codes. Everyone agrees that this practice is confusing, but it is so firmly established that to change it uniformly throughout the trade is next to impossible.

Horse Power.—The term horse power, when applied to the sale and purchase of boilers, has two current meanings. The first and true meaning is the usual mechanical energy equivalent of the heat output of the boiler. This is known as the developed horse power. The second is a throw-back from the customs of the trade and is defined as 10 sq. ft. of heating surface equalling one nominal horse power. The first, depending on the boiler type and its firing equipment, may be anywhere from 125 to 300 per cent of the latter, or higher in special cases. This percentage is called the "boiler rating". The terms horse power and boiler rating are now becoming obsolete in connection with watertube boilers, and the sooner we get rid of them from our fire-tube boiler terminology, the better. It should be emphasized here that the capacity of a boiler should not be judged by its heating surface, unless the disposition of that heating surface is also considered. Surfaces exposed to gas or flame radiation will absorb a great deal more heat than those gaining their heat by gas convection only. Also, gas velocity and gas direction relative to the tubes play a large part in the efficiency of heat pick-up.

Furnace Heat Release. — The amount of heat released by the burning of a fuel in a furnace, measured in B.t.u. per cubic foot per hour. This is a meaningless term by itself, but it does give the designer a rough and ready means of checking his furnace volume provided he has sufficient data on similarly-shaped furnaces burning the same fuel at hand.

Grate Heat Release.—This is defined as the amount of heat released by the burning of a fuel on a grate, measured in B.t.u. per square foot of effective grate area per hour. Here again the figure is of use to the designer, provided he has sufficient similar data and experience to fall back on.

Efficiency.—Efficiency may be defined as the ratio (per cent) of the heat which has been added to the steam or water in the boiler, divided by the heat content of the fuel burned. The difference between these two quantities is, of course, the various losses which inevitably occur. By far the largest of these is the heat which goes up the stack.

Watertube v. Firetube Selection

There are two main classes of boiler: fire tube and water tube; the difference between them is simple. In a fire tube boiler, the hot gases travel inside the tubes and the water is on the outside. In a water tube boiler, the gases are outside the tubes with the water on the inside. Figures 1 to 4 indicate the three most common types of f.t. boiler and one type of w.t. boiler.

Boilers are again divided into the two sub-classes: low-pressure heating boilers, and power boilers. These subclasses are dictated by the low pressure and power boiler safety codes, which require different design considerations and manufacturing procedures for each. Of these codes, the A.S.M.E. boiler codes are the governing ones on the North American continent. They are supplemented and clarified for use in Canada by the C.S.A. boiler and pressure vessels code. These codes are administered in the various provinces by the boiler and pressure vessels inspection branches of the appropriate provincial departments and under the boilers and pressure vessels Act of each province. The low pressure boiler code covers steam boilers up to 15 p.s.i.g. working pressure, and hot water boilers up to 160 p.s.i.g. working pressure, or 240° F. water temperature. The power boiler code covers boilers operating at higher pressure or temperature.

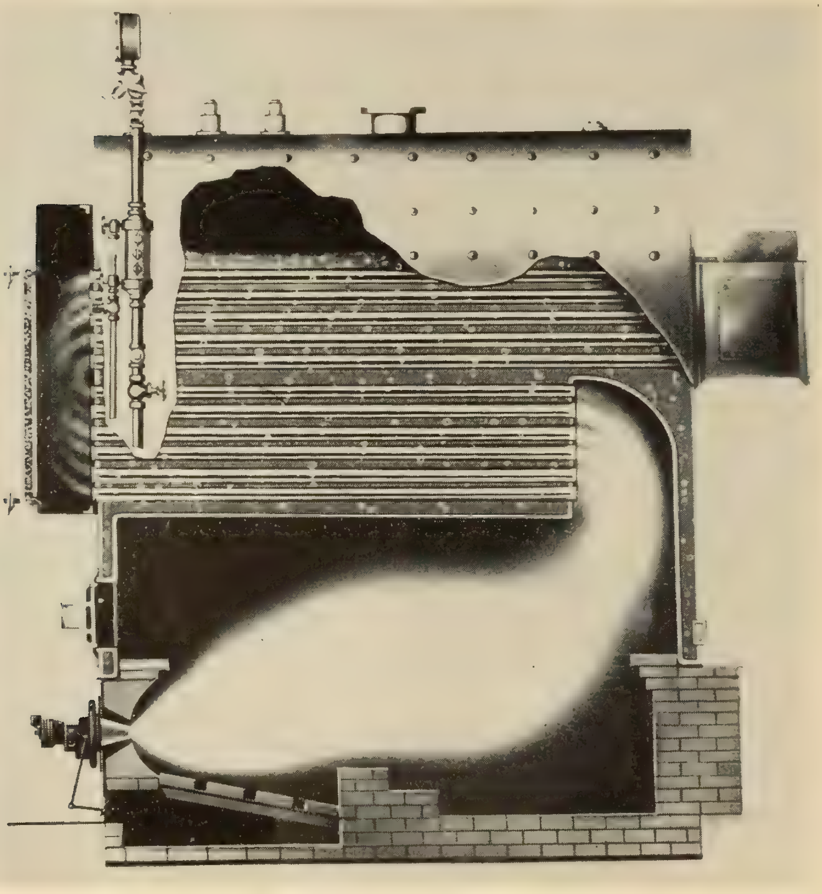
There are two principal considerations which govern the choice of fire tube versus water tube boilers: The most important of these is capacity, and the second, design pressure.

A fire tube boiler will become unmanageably large for capacities exceeding 12,000 to 15,000 pounds of steam per hour (p.p.h.), while a water tube boiler will become non-competitive in price if the capacity per unit is much under 10,000 p.p.h.

For the second consideration, design pressure, it has been found that for pressures exceeding about 250 p.s.i., the fire tube boiler shells and heads become too thick for good heat transfer, and the staying of flat surfaces becomes difficult and expensive. On the other hand, the water tube boiler, because of its higher first cost, becomes uneconomical in the low-pressure heating field.

It can be seen, then, that once the operating pressure is settled, there is only a narrow band of capacities between about 8,000 p.p.h. of steam and 15,000 p.p.h.,

Fig. 1. Waterleg type heating on brick base, oil fired.



where the choice between fire tube and water tube boilers is not clear-cut.

Within this band there are several secondary factors which singly or together will govern the final choice.

Of these factors, the size and shape of the unit is probably the most important since floor space and ceiling height are often restricted. In Fig. 5 and 6, the comparative sizes of the principal classes and types of boiler are illustrated and drawn to scale. Each one shown has a capacity of 10,000 p.p.h.

Fuel is another secondary factor affecting choice of class and type. For any one fuel or combination of fuels, furnace design requirements must be considered, and this will affect the boiler choice.

A third factor is that of demand. If the demand on the boiler is going to be continuous, or if a brief weekly shut-down for cleaning would be embarrassing, the water tube boiler should be chosen. It can, with proper operation, remain on the line for months at a time without shut-down.

The fourth factor, and the last one to be discussed here, is the problem of water treatment. The w.t. boiler, with its high steaming rate and small water content, is sensitive to scale-forming. It consequently requires more accurate and meticulous feedwater treatment than the f.t. boiler. This in turn demands a higher degree of skill in the operator than does the f.t. boiler with its larger water content and slower steaming rate.

Fire Tube Boiler Selection

(A) Suppose that our analysis of one job has led to the selection of a fire tube boiler of the low pressure heating type. In this field, the waterleg and the scotch type boilers predominate. The question of dimensions comes first and can soon be disposed of. It can be said that the waterleg type is always much higher, somewhat shorter, and about the same width as the scotch type. The first cost will be about the same. The scotch boiler, because of its furnace arrangement, is not normally used to burn coal, although this has been done successfully. The waterleg type can burn either oil, gas or coal, and can be readily converted from one to the other. It is, however, more difficult to keep clean in the water spaces, and when set on a brick base for oil firing, may require more brick maintenance. With these factors in mind, the choice between these two types should be easy.

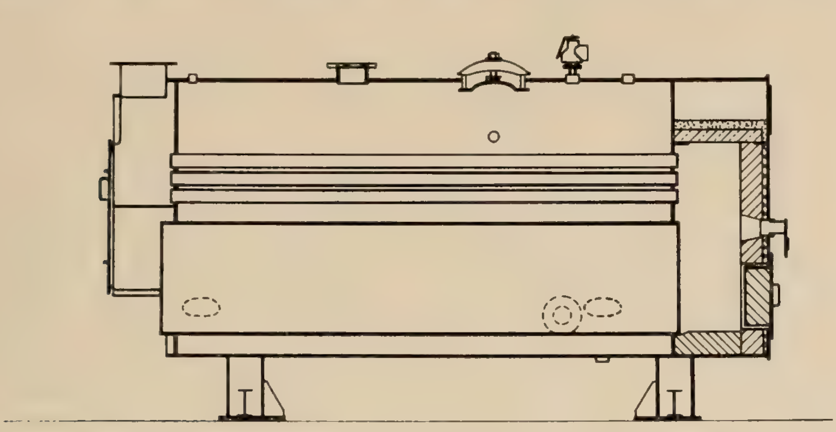


Fig. 2. Scotch dryback boiler, heating or power, oil fired.

Both types are suitable for either steam or water heating systems. The hot water boiler is much simpler to install and operate than the steam boiler. It is, however, at a disadvantage where the distribution system to the radiators is complicated, where the radiators must be kept small, and where steam in any quantity is needed for cooking or other reasons. It should be borne in mind when making a choice between steam and hot water boilers that one can always get hot water from a steam boiler through a heat exchanger but, with a water boiler, the temperature of the water is so limited that steam production from it is not practical. As a word of warning here, domestic hot water should not be taken from a closed hot water heating system on account of the make-up water endangering the boiler through scale formation or oxygen corrosion.

High-temperature high-pressure hot water for heating is being used more extensively now than heretofore and has much to recommend it for large central heating plants. The principle is simple in that there is a steam space maintained either in the boiler or in a collector drum. The water in the boiler is therefore kept at the steam saturation temperature corresponding to the pressure used (usually about 125 p.s.i.). Circulation through heat exchangers supplying hot water or steam to the radiators is effected by means of circulating pumps. The advantages over low-pressure hot water are that the main distribution lines are smaller and that high-pressure steam can be made available for laundries and the like, either through heat exchangers or directly from the collector drum. The principal disadvantage is its first cost since the boiler must be made to the power boiler code, heat exchangers supplied, and the pipelines made to withstand the higher pressures involved. The class of operator is required by law to be higher and adds to the operating cost.

(B) Suppose, alternatively, that the analysis of the job had indicated the need for a fire tube steam boiler operating at a pressure in excess of 15 p.s.i.g. This automatically puts it in the higher-priced power boiler field. Two typical cases would be that of a small institution requiring 100 to 125 p.s.i.g. for its laundry dryer rolls, and that of a food processing plant where the higher temperature of high-pressure steam speeds up the cooking process greatly. In both cases, the building heating requirements can be taken care of by low-pressure hot water or steam procured through heat exchangers or reducing valves respectively.

Although some types of waterleg boiler can be designed to meet the safety requirements of the power boiler code, the difficulty of doing adequate inspection and cleaning has decreased their popularity in this field. This leaves the scotch boiler competing with the H.R.T. type. The latter, because of its furnace arrangement, will usually be used if coal is to be burned. If oil or gas is to be the fuel, the scotch boiler has the advantage of compactness, lower brickwork maintenance, and lower first cost. It has therefore almost completely displaced the once-popular H.R.T. for this application.

Water Tube Boiler Selection

We will now proceed to the analysis of a job where one or more water tube boilers are to be used. So far, there has been no mention made of the important effect of load conditions on the size and number of boiler units and their desired efficiency. These factors will now be discussed in connection with a water tube boiler installation of the power type. Most of these remarks, however, apply with equal force to a fire tube boiler installation, but have been included here to avoid repetition.

As indicated in Figures 7 to 11, there are two principal "standard" types of w.t. boilers in common use today: the cross-drum type and the longitudinal drum type. Space and shape considerations will usually decide which is most suitable for the job. In general, the cross-drum, for the same capacity and efficiency, is higher, shorter, and about the same width as the longitudinal drum.

We can assume, of course, that the maximum continuous, as well as peak and minimum plant loads are established, together with the daily and seasonal load demand curve. From these data can be determined the load level at which most of the fuel will be burned. This is the level at which the boiler efficiency should be a maximum. It is obvious that for peak loads of short duration, it would not be economical to install a boiler with its highest efficiency at maximum load. This is particularly true if very low loads are to be handled at other times with the inevitable "low fire" difficulties of a too-large boiler.

There are two main factors to be considered when selecting the number and capacity of the boilers needed. These are: *(a)* standby requirements, and *(b)* load variation.

Standby requirements alter with the kind of service. For example, hospitals, and public buildings involving tenant occupancy, cannot take a chance on even a partial failure of their heating plant during the winter months. Consequently, they must have at all times idle capacity of some percentage of their maximum demand. W.t. boilers have reached a state of reliability where one idle boiler out of three is considered adequate standby. In small plants, this ratio, for reasons of economy, may be one idle out of two installed. Many process plants, such as distilleries and sugar refineries, where a partial failure of steam supply would be expensive to the process, use the same standby ratios as hospitals and institutions. Others, where partial failure would be merely an inconvenience or, at worst, a temporary reduction in production which could be made up later, do not provide for any *idle* capacity at maximum load. Instead, they provide *surplus* capacity. In a two-boiler installation, for instance, each boiler would have a capacity of about 65 to 75 per cent of the maximum load demand. If one of these boilers had to be shut down at a time of maximum demand, some non-essential services could be discontinued or reduced.

Seasonal load variation is often the deciding factor in choosing the number of units in a plant. It is difficult and uneconomical to operate a boiler at too small a fraction of its normal capacity. The efficiency drops drastically, and the flue gases tend to condense on and corrode breechings. In institutions and the like, where standby capacity is installed, the seasonal load variation is automatically provided for only if more than two units are installed, so that some of the two or more boilers which carry the maximum load in the winter can be shut down in the summer. It is not uncommon to see one out of three, or one out of four, such units carrying the entire summer's load at less than half capacity. It is worth considering, in such cases, the addition of a small fire tube boiler for summer use.

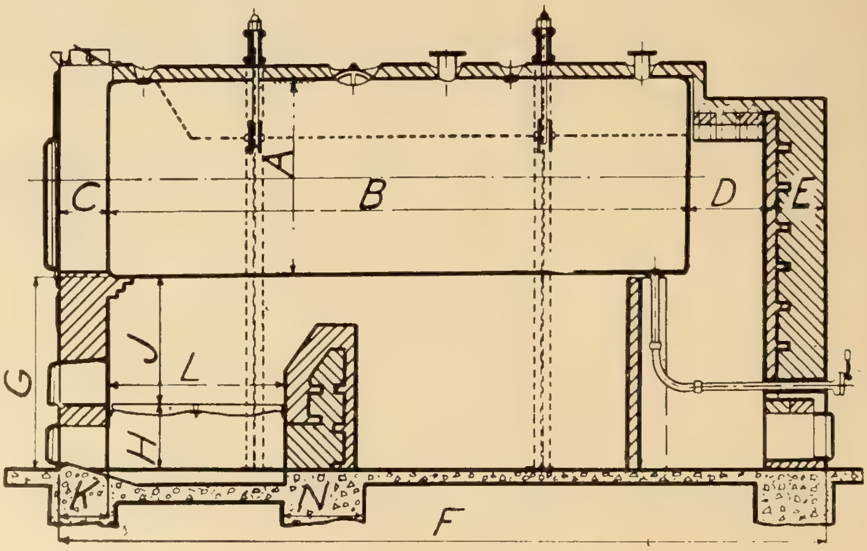
It should be noted also that the fewer the units used, the lower will be the first cost. Two boilers of a given capacity will cost about 50 per cent more than a single boiler of the same total capacity and their maintenance costs will be in about the same proportion. A good rule to follow is to use as few units as possible, taking into consideration standby and load variation requirements.

Before leaving the subject of w.t. boilers, it is worth mentioning efficiency. It was stated before that a boiler's maximum efficiency should be reached at the rating at which most of the fuel is to be burned, and that the boiler's heating surface should be decided on that basis. How high we should aim for efficiency is not always clearly understood. Higher efficiency can usually be obtained by increasing the heating surface, installing heat recovery equipment, or arranging the heating surface so more of it is exposed to direct flame radiation. All of these methods cost money and, unless the additional cost can be recovered in a reasonable time—say, 10 or 12 years (with interest)—it is not worth doing. Here is where the load variation comes in again. There may be two plants to be installed with identical maximum loads, one of which may have 50 to 100 per cent higher yearly load factor than the other and burns that much more fuel. Obviously, a high efficiency is economically more justified in one than in the other. More will be said about this later when economizers and air heaters are discussed.

Laws Affecting Operators

We will now discuss the effect

Fig. 3. Horizontal return tube boiler, heating or power, hand fired.



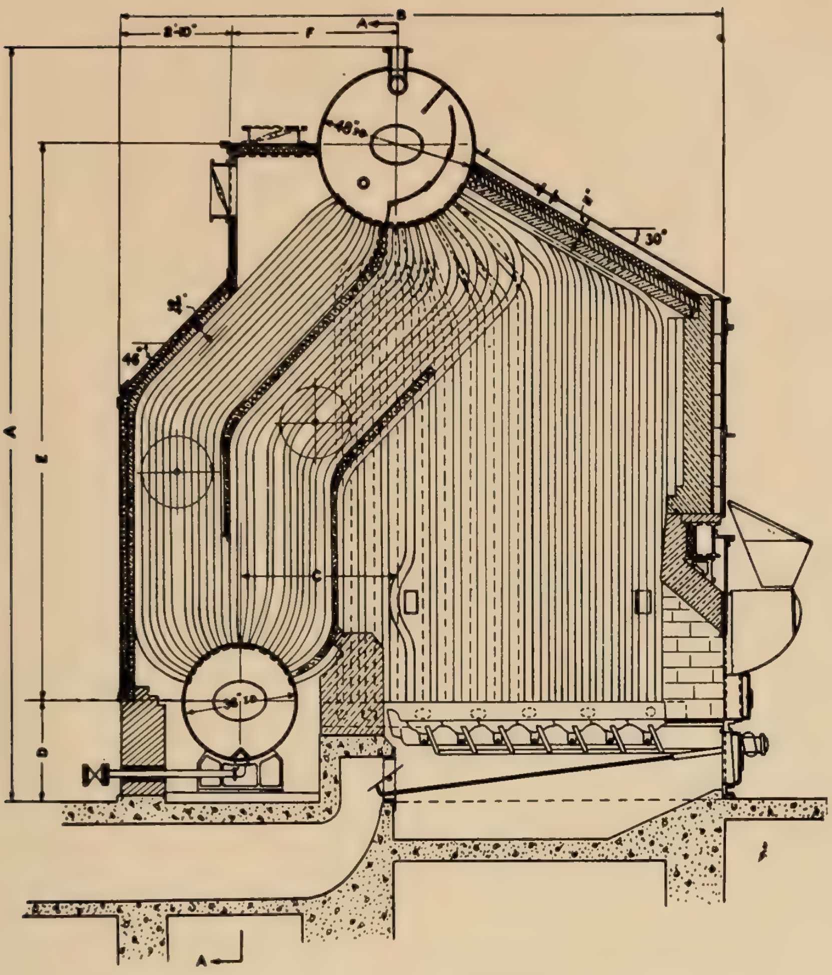


Fig. 4. Water tube boiler, cross drum type, spreader stoker.

of our Provincial laws on the selection of boilers, particularly as they affect the grade of operator required. This, of course, has a striking effect on operating cost. Each province has an Act and regulations stipulating the maximum total installed heating surface permitted for unattended boilers. The Provincial Acts give these limits in horse power rather than in heating surface. The Acts are somewhat confusing in that different classes and types of boiler have different defined values of horsepower. In Quebec and Ontario, for example, the following quantities are the maximum permissible heating surfaces for mechanically-fired, unattended boilers, in the low-pressure field:

H.R.T. boilers:	
Quebec:	900 sq. ft.
Ontario:	1125 sq. ft.
S.D.B. and Waterleg boilers:	
Quebec:	825 sq. ft.
Ontario:	900 sq. ft.
W.t. boilers:	
Quebec:	640 sq. ft.
Ontario:	750 sq. ft.

The corresponding limits for high pressure boilers are: Quebec, one fifth of the low pressure ones; Ontario, one third.

There are also limits established in the Provincial Acts for the maximum installed horsepower which each class of operating engineer is permitted to handle. In Quebec, for example, an operating engineer with second class papers can have charge of a high pressure water tube boiler plant, mechanically fired, with a total installed heating surface not exceeding 5100 sq. ft. In Ontario this figure is 6000, and in Alberta 5000.

It is apparent from the above that the plant designer should, after making his boiler choice, reexamine the sizes chosen from the point of view of legal requirements. Often, a slight increase in boiler rating, a small reduction in standby capacity, or a reduction in the provision for future load growth, will put the plant in another operator's class.

Package Boilers

Before passing on to the discussion of firing equipment, we will take a look at the modern trend toward "package" boiler units. A boiler, either fire tube or water tube, can be called a package unit if it is assembled in the manufacturer's shop complete with all necessary components such as brickwork and insulation, firing equipment, draught fan, combustion and water controls, fuel heaters and dumps, standard boiler trim and, frequently, feed water pumps and soot blowers. This package is so designed and arranged that it can be shipped to site as a unit without too much danger of damage in transit to its installed brickwork and the more fragile of its components. In theory, all that remains to be done once the boiler is in place is to connect up the water, steam, fuel and electric lines, push a button and you're away. In practice, this is almost true, since the equipment has already been shop tested, with the possible exception of the combustion controls. The test procedure of some manufacturers, for reasons of overall economy, do not include this. So far as the writer knows, most packages sold today are either oil or gas fired, or both, and cannot be converted to the use of coal.

The scotch dry-back type of boiler forms the basis for all fire tube packages. This type is enjoying a wide popularity in both the United States and in Canada at present and constitutes the vast majority of all packages sold. Water tube boiler packages are a recent innovation and are gaining in popularity, particularly in the United States, where the large market makes quantity-production methods practical and economical. Due to shipping weights and clearances, the water tube package is limited to the small and medium capacity field, the output varying between 7500 p.p.h. and 35,000 p.p.h. It is interesting to note here that a 30,000-p.p.h. package has a shipping weight of 40 tons. This presents no mean handling problem and points up the moral that no one should specify a water tube package without first checking on the handling facilities at the site and getting an approximate idea of what it is going to cost to move it from car or truck into place in the boiler room. It is certain that in many cases it would be cheaper to install a field-assembled unit instead of a package if all such fringe costs are included.

Fuel Selection

We will now proceed to the important question of fuel selection. A few years ago, most heating boilers and shell-type fire tube boilers were coal fired by hand on shaking grates, much the same as most of us did in our domestic furnaces. Today, oil and gas have cut sharply into the coal-burning field for the small and medium sized boiler, and mechanical stokers have almost completely replaced hand firing. We will, therefore, discuss fuel for mechanical firing equipment only and outline a few of the principal factors governing its selection.

There are four main possibilities: to burn coal or coke, oil or gas, and the choice is usually made on a basis of cost and convenience. Of these, cost is by far the more important. Many boilers burn, annually, fuel costing between half to twice the initial value of the installation. It is obvious then, that a careful study of the cost of alternative fuels is more than warranted.

There are many things, some of them not too apparent, that affect the over-all cost of a fuel. Let us take coal and coke first and enumerate them:

(1) Initial investment for firing equipment including special furnace requirements.
(2) Initial investment for combustion controls.
(3) Initial investment for coal handling equipment.
(4) Initial investment for ash handling equipment.
(5) Initial investment for fly-ash collection equipment (if used).
(6) Initial investment for coal storage facilities.
(7) Cost of fuel per M.B.t.u., f.o.b. site.
(8) Cost of unloading.
(9) Cost of handling fuel from storage to boiler.
(10) Cost of handling ash from boiler to dump.
(11) Cost of boiler room staff wages.
(12) Cost of maintenance (all equipment).
(13) Boiler efficiency.

This is a formidable list of costs but, if approached systematically in the planning stage, they are not as difficult to determine as one might think. Some of them, however, deserve special mention:

The initial cost of the coal and ash handling equipment may, in a small heating plant, cost only a few dollars and consist merely of a couple of shovels and a wheelbarrow. In a larger plant they may amount to many thousands of dollars and consist of such items as track hopper, bucket elevators, storage bins, conveyors, pneumatic ash handling systems, etc. Whether such labour-saving devices are warranted or not depends largely on the amount of coal to be handled daily.

Consider the fly-ash collection equipment. In general, this is not needed by the owner for his own purposes, but is a requirement demanded by the smoke-abatement laws of most large urban centres when certain types of coal firing equipment are used.

The last item listed, boiler efficiency, enters into the balance sheet when comparing coal costs with those of oil or gas. This is due to the fact that it is virtually impossible to burn out a coal completely. There are, therefore, what we call "unburned" losses in our heat balance figures which do not apply when burning oil or gas and help weigh the efficiency figures against coal.

A corresponding list of cost factors for oil or gas firing would be as follows:

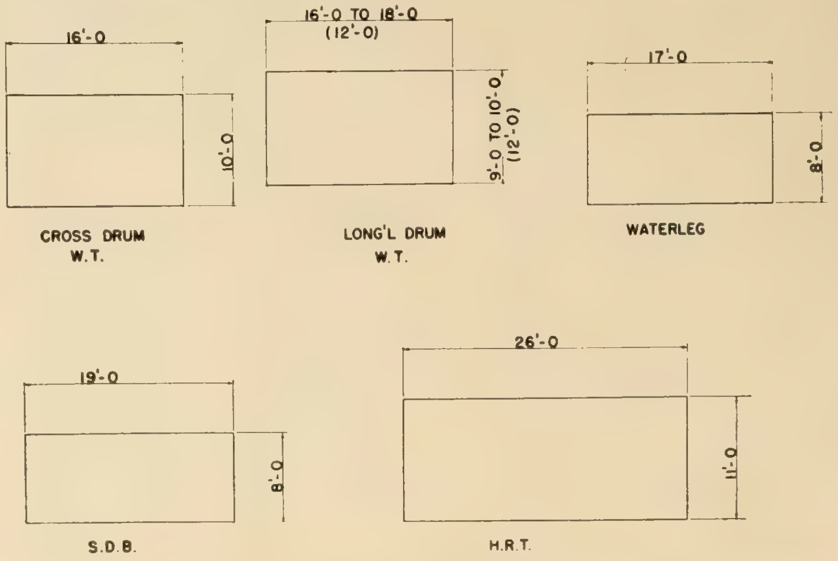
(1) Initial cost of burners.
(2) Initial cost of combustion controls.
(3) Initial cost of safety devices.
(4) Initial cost of oil heating and pumping equipment.
(5) Initial cost of oil or gas piping, valves, etc.
(6) Initial cost of oil storage facilities.
(7) Initial cost of oil unloading facilities.
(8) Cost of power for heating and pumping oil.
(9) Cost of fuel per M.B.t.u., f.o.b. site.
(10) Cost of unloading (other than power).
(11) Cost of boiler room staff wages.
(12) Cost of maintenance (all equipment).
(13) Boiler efficiency.

Certain of the above items will stand elaboration:

Item (3), safety devices—add perhaps 10 per cent to the initial cost of an oil or gas burner installation. They are, however, considered to be a "must" for burners in small automatically controlled self starting jobs. You will find them on your own oil burning domestic furnace. On larger jobs, with modulating controls—but not self starting—they are being used more and more, largely as a protection against human errors in operation and not so much to protect against mechanical failure. More and more the insurance companies are insisting on such devices before they will agree to insure.

Item (4) to (8) inclusive, having to do with the storage, heating, and transfer of oil are a common source of under-estimate. The storage and transfer facilities are

Fig. 5. Comparison of floor areas required, various types of boiler.



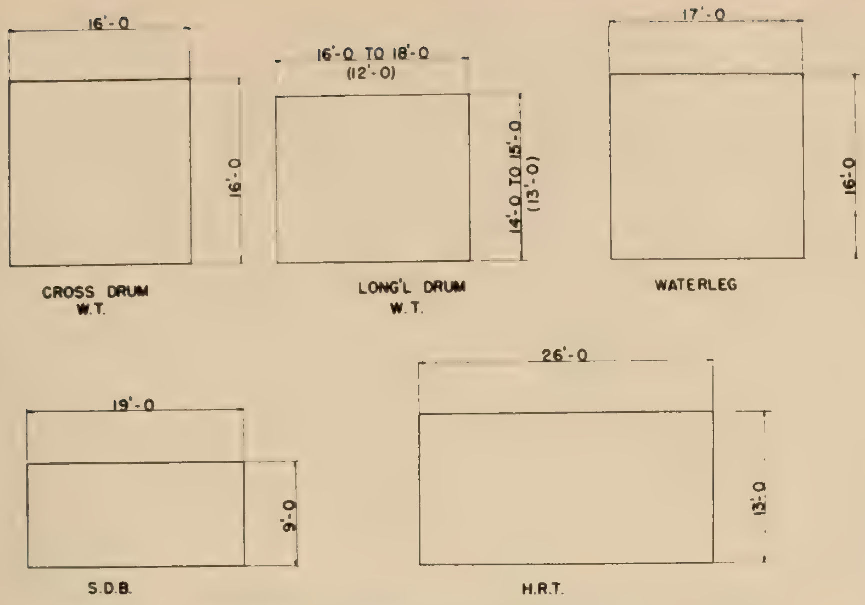


Fig. 6. Comparison of heights required, various types of boiler.

strictly controlled by the fire underwriters and, in these days of high plumbing and material costs, may form a surprisingly large percentage of the total cost—even exceeding the cost of corresponding equipment for coal.

Item (11), boiler room wages, usually shows a substantial saving over a coal-burning job, even if the latter is fully mechanized.

Item (12), maintenance costs, will usually be considerably less with oil or gas as a fuel than with coal. Stoker grates have a tough job to perform, but any stoker manufacturer can predict fairly accurately what the maintenance cost per ton of coal burned per year will be. The same goes for pulverizers. On the other hand, the burner tips and gas rings of oil or gas burners are exposed to severe conditions also, but are comparatively inexpensive to replace. Other components of the system such as pumps, heaters, valves, etc., operate under good conditions, and their mechanical deterioration can be kept very low by preventive maintenance.

This has been a brief summary of the main cost factors affecting the choice of fuels. We will now proceed to what we call the "convenience" factor.

It is apparent that this convenience factor is all in favour of oil or gas and against the use of coal. Many jobs have been installed with liquid or gaseous fuels, even when the economics were strongly in favour of solid fuel.

In the first place, it may not be convenient to allocate the space for coal storage when underground oil tanks offer so little obstruction. Secondly, some types of industry tend to make show places out of their boiler rooms, and this can more easily be done and maintained in the relatively dust-free atmosphere of an oil or gas fired job. Thirdly, it is not difficult to obtain operators who can operate an oil fired plant efficiently, but good stoker or pulverizer operators are more difficult to find. Fourth, there are numerous plants where cleanliness is essential to preserve the quality of the product.

These cannot tolerate coal dust, ash, or fly ash blowing about and will use oil or gas if it is at all feasible. Lastly, there is the very numerous group of small heating plants with unattended boilers operating entirely automatically except for cleaning and routine maintenance. For these, oil firing is not only a convenience, but may become a necessity if it is desired to keep operator attendance to a minimum.

Firing Equipment Selection

If the decision is made to burn coal (or coke) the type of stoker or pulverizer best suited for the job must be selected. The type chosen will depend principally on three factors as follows: (1) Is the coal caking or free-burning? (A caking coal is one which tends to fuse together and become impervious to air passage when heated.) (2) Capacity desired. (3) Rate and magnitude of load variations.

There are several types of stoker available, and each has its advantages and disadvantages.

The Single Retort Underfeed Stoker, as its name implies, introduces the coal under the fuel bed by means of a single screw or ram. The screw type, because it can deliver coal to one exit point only, has a limited capacity and is used mainly for small heating boiler jobs. The ram type employs a piston to force coal into a central trough, and auxiliary pushers to distribute it over the length of the trough. Capacities up to 40,000 p.p.h. can be obtained with the largest sizes available. Because of the constant motion of its fuel bed, the underfeed stoker can burn caking coals successfully. Any cakes that form are broken up immediately into fine enough particles to permit efficient air penetration. This type of stoker cannot be used where it is necessary to follow rapidly fluctuating load demands. It is, however, very simple to operate and is generally regarded as the "old reliable" of the small, steady load field.

The Multiple Retort Stoker was once extensively used in medium and high capacity plants. It has been largely supplanted now by the spreader and travelling grate stokers in the medium range, and by pulverizers in the high capacity range. Coal feed is effected by a parallel battery of rams feeding on to a stepped and rearward sloping grate. Secondary feeders nudge the coal down the slope toward the rear where the ash is either dumped or disposed of by mechanical means.

The Spreader Stoker (in its modern form) is a comparative newcomer in the stoker field but has already attained a large measure of popularity within its capacity range. Its principle is simple. Coal is fed by two or more variable speed feeders in parallel on to rotors which throw it backward onto a grate. The coarse particles are thrown furthest, the finer particles less far, and the very fine particles and dust burn in suspension. By proper proportioning of the small and large particles, a thin, even, fuel bed can be maintained. Almost any kind of coal can be burned so long as sizing is right. Rapid load fluctuations can be followed without difficulty. Since there is a practical limit to the distance the coal particles can be thrown evenly (12 to

13 ft.), the higher capacities must be attained by widening the boiler and increasing the number of feeder and rotor units proportionately.

There are two methods of cleaning the fire. The first is by means of longitudinally zoned dumping grates, each zone corresponding to one feeder and rotor unit. One unit is dumped at a time and, during that time, both capacity and efficiency suffer. For this reason, a minimum of three zones is often specified for small boilers in order to reduce the percentage of outage during the cleaning period. When the boiler capacity gets up around the 40 or 50 thousand p.p.h. mark, the chore of dumping the multiple zones in sequence becomes too onerous, and recourse is had to the continuous discharge travelling grate. Unlike the conventional travelling grate, this one travels from rear to front. This principle gives the larger particles, which were thrown furthest back, time to burn out before being carried over into the ash pit. Spreader stokers of this type are being used regularly up to 125,000 p.p.h. and, in a few cases, even higher. In this respect they now overlap what used to be considered the exclusive range of pulverizer firing.

There are four important features, however, of spreader stoker firing about which we should warn the prospective user. First, it is essential that the furnace be designed to give plenty of length of travel for the particles in suspension to burn out before they encounter the first pass of boiler tubes. Secondly, it is necessary to keep the furnace temperature down to prevent softening of the fly ash with resultant fouling of the first pass tubes. These two requirements add to the boiler dimensions as compared with one designed for underfeed stoker firing and this, of course, is reflected in the cost. The third warning is that the spreader does not function well at low loads. About 25 per cent of full capacity is generally agreed to be the practical minimum. This limitation will often rule out the spreader unless the boiler units are made small enough to permit one of them carrying the minimum plant load without the fuel bed becoming too thin and spotty. The fourth warning is that the spreader stoker is one of the worst offenders when it comes to emitting objectionable fly-ash and cinders. As a result, dust collectors are required by law in conjunction with spreaders in most urban centres. Even where by-laws do not demand dust collectors at present, there will likely be such a requirement some day, and the wise purchaser will leave space somewhere between his boiler and stack for one to be installed in the future.

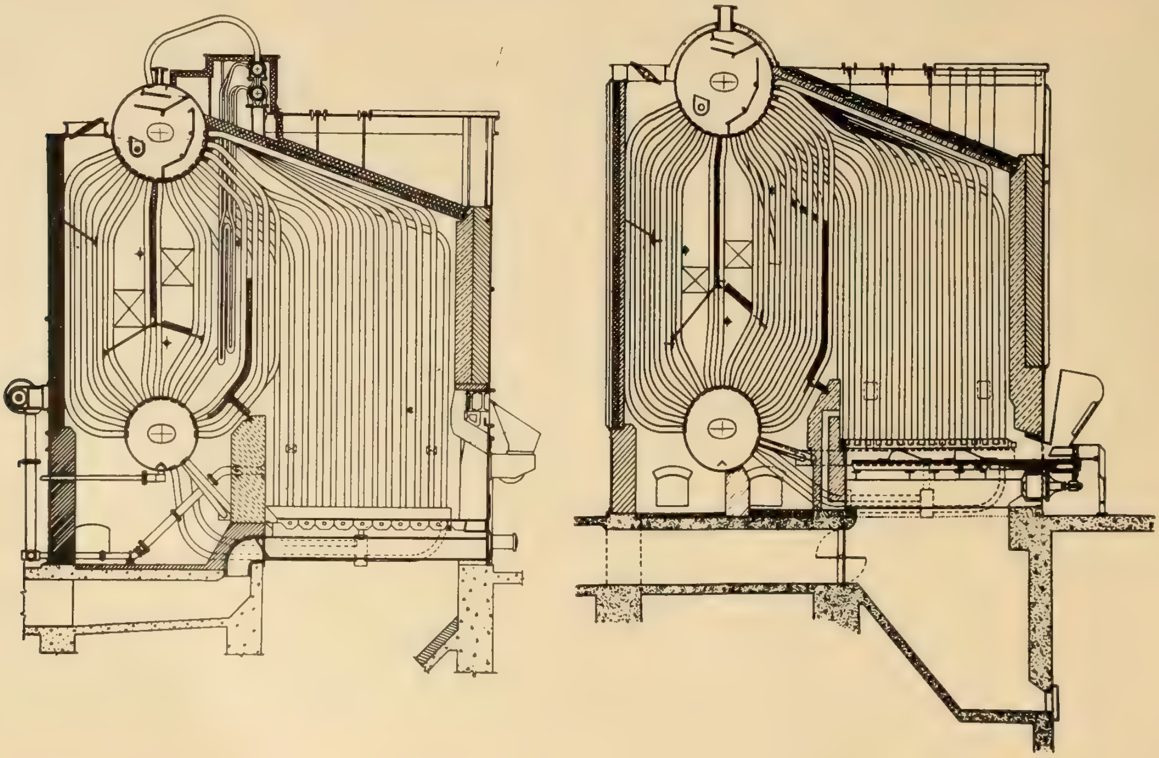


Fig. 7. Water tube boilers, cross drum type, dumping grate spreader and underfeed stokers.

It is worthy of note here that most boilers have some place in their gas passes where the larger particles are trapped. A fair percentage of these particles will be found to be unburned carbon. Consequently, for reasons of efficiency, it is standard practice with spreader installations to return these cinders to the furnace via an auxiliary air operated cinder return system.

The Travelling Grate Stoker has a wide range of capacity extending from about 15,000 p.p.h. of steam up to 250,000 p.p.h. There are two limitations to the use of this type of stoker other than its economic capacity range. It cannot follow rapidly fluctuating loads with best efficiency, and it cannot efficiently burn caking or semi-caking coals.

In principle, the grate is an endless belt conveyor whose top surface travels from the front toward the rear of the boiler. Coal is fed on to the grate through a guillotine-type gate from a hopper at the front of the boiler. The amount of opening of the gate regulates the fuel bed depth, and the burning rate is regulated by the rate of travel of the grate. Air is fed under the grate through transverse zoning chambers which permit the burning rate to be varied from front to rear. To obtain best results and minimize the likelihood

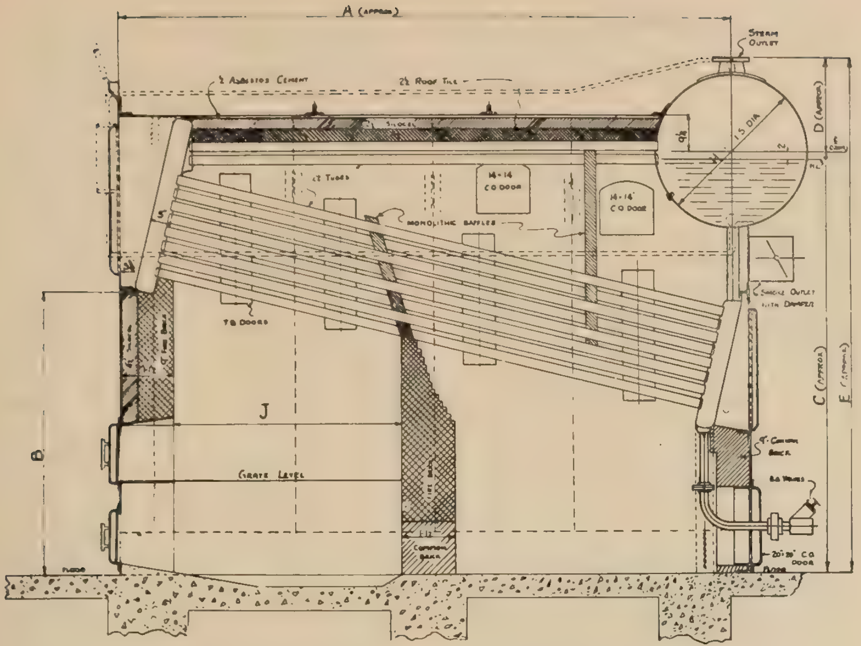


Fig. 8. Water tube boiler, cross drum straight tube, hand fired.

of the fire going out, it is customary to do as much burning as possible in the zones nearest the gate. This gets the raw coal ignited as rapidly as possible and gives it time to be burned out in an even, orderly fashion before it is dumped as ash at the rear of the furnace. It has been found that an overhanging arch over the first zone greatly assists in getting the raw coal ignited. With some fuels, notably coke breeze, a long rear arch is desirable to ensure relatively complete combustion. These arches, and the general design of the furnace for this type of stoker, make for a more expensive boiler than would be required for the same capacity were a spreader or underfeed to be used. In spite of this added cost, where the capacity desired exceeds the upper limit of the underfeed, and other considerations rule out the spreader or pulverizer, the travelling grate is frequently the only solution.

For the guidance of a prospective purchaser, it is worthy of note that there are two sub-types of travelling grate. The less expensive type is known in the trade as the chain grate. With this sub-type, the grate surface is made up of the chain links which are threaded on to long pins extending the width of the stoker. Special links at each side engage the drive sprockets. The principal disadvantage of this sub-type is that to replace a grate element, the stoker chain pins must be pulled and then reinstalled after the links are replaced — a time-consuming operation.

The other sub-type is known as the travelling grate—somewhat to the confusion of the uninitiate. A more accurate designation would be the "bar and key" grate. This grate differs from the chain grate in that the grate elements (keys) do not form part of the chain proper and hence can be renewed readily and with little loss of time. Since the chain elements are not at the firing surface, a much higher degree of mechanical perfection can be attained in their design, and this is reflected in lower maintenance costs and less outage time. Furthermore, by varying the width of the grate elements and the proportions of the air slots between them, finely divided fuels can be burned without excessive sifting of fuel or ash through the grate. This characteristic can be attained on the chain grate also, when new, but as the chain wears, the spacing between links increases and the advantage is eventually lost.

We can sum up the relative usefulness of the two sub-types of grate by saying that the travelling grate has a higher first cost than the chain grate, but is usually chosen in preference to the latter where the load demand requires a minimum of outage time and fine sifting fuel is to be used.

Pulverizers

Let us now touch briefly on the burning of pulverized coal. To be very elementary, we can say that pulverized coal firing consists of reducing the coal particle size to a point where, if blown by air carrier into a furnace, it will burn in suspension.

The two principal components of any pulverized fuel firing system are the pulverizer and the burner. There are many varieties of burner in use, and it is not proposed to go into their relative merits here. It should be noted, however, that pulverized coal firing is the only method of burning coal which permits easy conversion of the boiler furnace to oil or gas. In fact, there are many installations where combination coal-oil burners are installed and both fuels are used as the economics of fuel cost changes.

As for the major element of the system, the pulverizer, there are three main types: the ball mill, the impact-attrition mill, and the roll-race or ball-race mill. The ball mill consists of a rotating drum containing a number of hardened balls. Coal is introduced into the drum and is pulverized by the tumbling action of the balls and the coal itself. The impact-attrition mill consists of a series of hammers or lugs attached to a rapidly rotating rotor in a closed housing. The hammers break up the larger particles and, by windage and attrition, these produce the finer particles. The roll-race and ball-race mills consist of rollers or balls confined in a race with the coal, which is crushed and pulverized as the ring or race rotates. In all these types, the finer particles are carried away from the grinding elements by an air stream, passed through a classifier which rejects the coarser of these and allows the real fines to proceed to the burner and hence to the furnace.

All of these types have their advantages and disadvantages, and all will do a good job if the conditions are right for their type. For example, the ball mill and the impact-attrition mills have a large power to production ratio if operated at fractional capacity, while the roll-race and ball-race types are unduly expensive in first cost for small capacity installations. There are other factors which must be considered in choosing the most suitable type of pulverizers, such as moisture content of coal, and length and frequency of shut-down time for replacement of grinding elements.

The designer of a pulverizer fired unit should, for satisfactory operation, satisfy himself that five basic conditions are going to be fulfilled. First, the minimum load must be such that the pulverizer can handle it without losing ignition. The use of a pilot oil flame to stabilize ignition at low loads is frequently used to avoid such difficulties. The use of two or more pulverizers per boiler would have the same effect. For this reason and to provide part load capacity in the event of temporary pulverizer failure, it has become standard practice to install two or more units per boiler in the load range of 60 or 75 thousand p.p.h. steam and up. Second, the boiler furnace must be so designed as to have a maximum temperature below the ash-softening temperature of the coal. If this is not done and if the flame travel is not adequate, slagging will be sure to occur. The common method of minimizing slagging in a furnace, other than making it of adequate size and shape, is to have the furnace wall tubes practically touching, thus presenting completely water-cooled surfaces. Some boiler manufacturers use a wider wall tube spacing with fins attached to the tubes to fill in the gaps. With these arrangements, the wall refractory maintenance is practically nil. Furthermore, the water-wall contour is such that any slag formed cannot get keyed on and will usually drop off when it gets heavy enough, or when the boiler cools off during a shut-down. Third, the coal available should have a reasonably good grindability and not too low an ash fusion temperature. It should also be properly sized for the type of pulverizer to be used. The pulverizer manufacturer will always specify the coal sizing limits for his product and it is frequently found economical in large installations to buy over-sized coal and install crushing equipment to reduce it to the required size. Fourth, the fly-ash emission from a pulverized coal fired boiler is very high and, as with the spreader stoker, most urban centres require dust collection equipment to be installed. Fifth, the intelligence and ability of the operating staff probably needs to be higher to fire pulverized coal than for any other type of firing. For this reason, the small plant which may not by law require a class one operator and can least afford to pay extra money for a first class man, frequently encounters more operational difficulties than the large one.

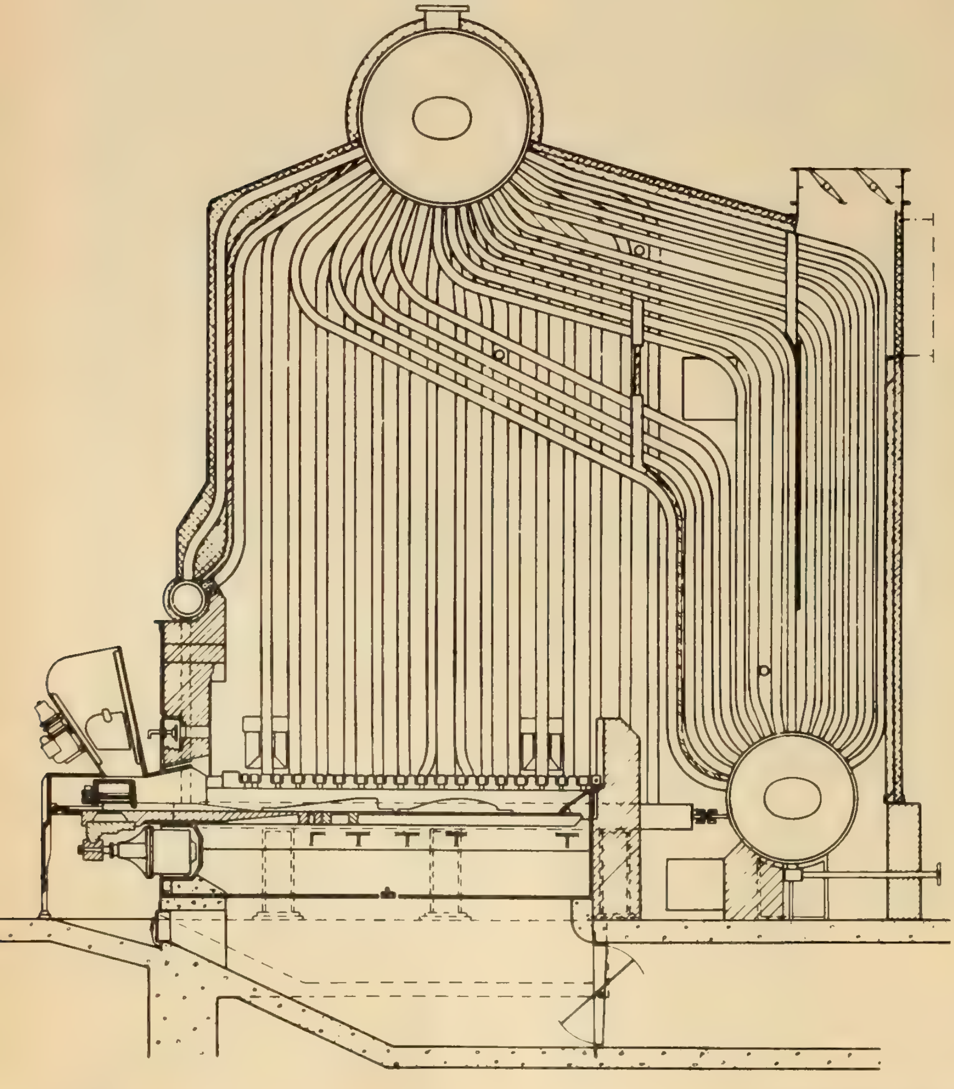


Fig. 9. Water tube boiler, cross drum, type E underfeed stoker.

Oil and Gas Burning Equipment, in common with coal burning devices, is available in several types. For burning gas, there are the gas ring burner and the inspirating burner. Which to use will depend on the gas pressure available, the noise level tolerated, and the individual preference of the purchaser.

For oil burning, there are four principal types: *(a)* the spinning cup, which introduces a fine spray of oil via the centrifugal action of a highly-polished spinning cone. These burners have medium to low capacity and are used principally with heating boilers; *(b)* steam atomizing burners, which use medium pressure steam for atomizing through a gun-type burner element, and have a wide range of capacity. These cannot be used for water or low-pressure steam boilers unless medium-pressure steam is available from some other source for atomizing; *(c)* mechanical atomizing burners, which atomize the oil by pumping it at high pressure through a gun-type burner element; *(d)* the steam-assisted mechanical atomizing burner which uses steam for atomizing at partial capacity and a combination of steam and mechanical atomizing at higher loads. By this means, the low turn-down ratio of steam atomizing is combined advantageously with the economy and efficiency of mechanical atomizing at high loads. How the oil is heated and pumped, and how the combustion air is handled for each type, is too long a story to be told here.

Heat Recovery Equipment

Heat recovery equipment will now be discussed briefly. When used in conjunction with boilers, heat recovery can be defined as the extraction of heat from the flue gases after they leave the boiler. The purpose, of course, is to reduce the heat loss up the stack and hence improve the overall efficiency of the unit. There are two methods of doing this. One is by transferring heat from the flue gas to the feedwater in an *economizer*, and the other is to transfer heat from the flue gas to the combustion air in an *air heater* or *air preheater* as it is sometimes called. Both these devices are simply a special form of heat exchanger. These methods of heat recovery are seldom used together, except in the high pressure power plant field and in conjunction with some types of marine boiler, both of which are beyond the scope of this paper. There are several types of economizer and air heater in common use, but space will not permit their description here. The discussion will therefore be limited to the factors deciding whether heat recovery will be used and, if so, which type, economizer or air heater, is best suited for the job.

Whether or not to use heat recovery equipment is usually strictly a matter of economics. It is common to improve efficiency 4 to 5 per cent with an air heater, and 4½ to 6½ per cent with an economizer, the limitations usually being: the minimum flue gas temperature that can be attained without gas condensation and resultant corrosion or fouling up of the unit; or maximum water temperature that can be attained in the economizer without danger of steaming; or maximum preheated air temperature permissible for reasons of grate maintenance and coal slagging on the grate.

If the annual fuel bill is known, it is a simple matter to calculate the gross savings that can be reasonably expected when heat recovery equipment is used. Against these savings must be balanced the amortized cost of the heat recovery equipment, its maintenance, the additional cost of draught fan and power needed to overcome the draft losses through the equipment and the cost of the additional space needed. Even if the economics of the case do not warrant it, air heaters will usually be installed in conjunction with pulverizers, to improve the combustion and dry the coal.

If it is decided to install heat recovery equipment, the next step is to choose between an economizer and an air heater. In general, for steam pressures up to 200 or 250 p.s.i., the air heater is a better investment than the economizer while, above that, the conomizer begins to show the best returns. The reason for this lies basically in the fact that the higher the operating pressure, the higher will be the temperature of the saturated steam in the boiler, and the higher will be the gas outlet temperature. This means that more heat can be extracted from the gas before its dewpoint is reached. This larger amount of available heat may exceed that needed by the air heater to bring the combustion air temperature up to the permissible limit, particularly for stoker operation. Consequently, with an air heater the flue gas temperature cannot, in a high pressure boiler, be lowered to the optimum point, and the best efficiency cannot be reached. On the other hand, as the boiler pressure increases, the temperature of the feed-water can also be increased and, as a result, the economizer, in heating the feedwater, can make use of the optimum amount of heat from the flue gases and hence produce the optimum efficiency.

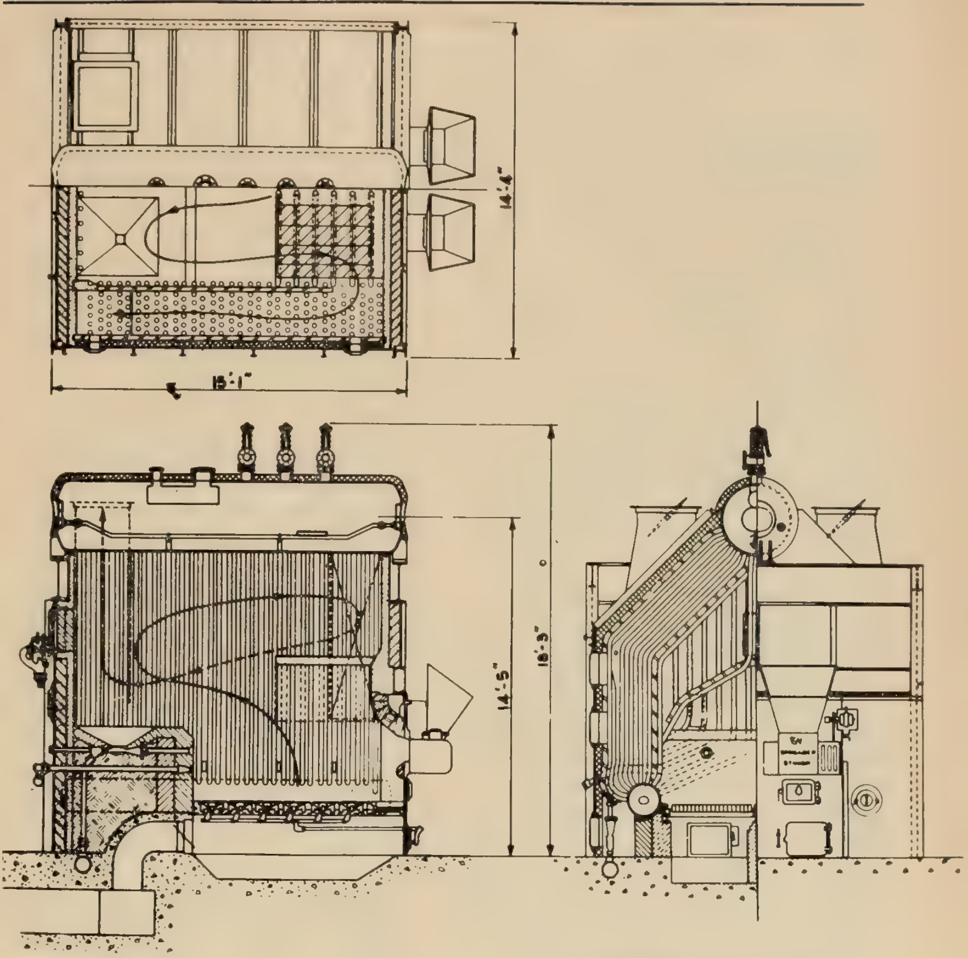


Fig. 10. Water tube boiler, longitudinal drums, dumping grate spreader.

In practice, the fields of application of the economizer and air heater are not so simply defined. For example, it will be found that an economizer will cost more than an air heater for the same pick-up. Against this is the fact that an air heater is likely to have cold spots, particularly at partial load, where condensation is likely to occur. It is therefore considered unwise to reduce the average gas temperature as low with an air heater as with an economizer. This is particularly true with oil firing where sulphur compounds are found in varying amounts in the flue gas. These compounds tend to condense and form hard insoluble deposits at temperatures around 300° F. and may require strong-arm methods for removal. To overcome these operating difficulties, air recirculation, air by-pass, or steam heater at the air entrance can be used to advantage. The critical gas temperature for various loads can then soon be determined and avoided by an operating procedure which will give best efficiency without danger of slagging.

Soot Blowers

The question of fouling heating surfaces leads naturally to the subject to soot blowers. Soot blowers may use either air or steam as the blowing medium and be installed in air heaters, economizers, and boilers of all types. When air is used, the blowing cycle is usually continuous and the operation completely automatic. This type is units as the cost is too high for normally used only on large boiler economic use in small boilers. Steam blowers, on the other hand, are relatively inexpensive. They are usually arranged for hand or semi-automatic operation once per shift or when rising flue gas temperatures indicate the need for blowing.

Whether or not to install soot blowers depends largely on the construction of the boiler and the load characteristics. Even a small firetube boiler, if it cannot be shut down for brush cleaning without interrupting important plant functions, should have soot blowers installed. Practically all water-tube boilers need to be on the line for long periods at a time and in addition have relatively inaccessible heating surfaces. Consequently, they normally require soot blowers. An exception is often made to this rule in the case of gas-fired boilers and occasionally where spreader stokers are installed. In the latter case, the scouring action of the cinders is said by some to keep the heating surfaces clean, but this has not been generally substantiated.

Fans and Chimneys

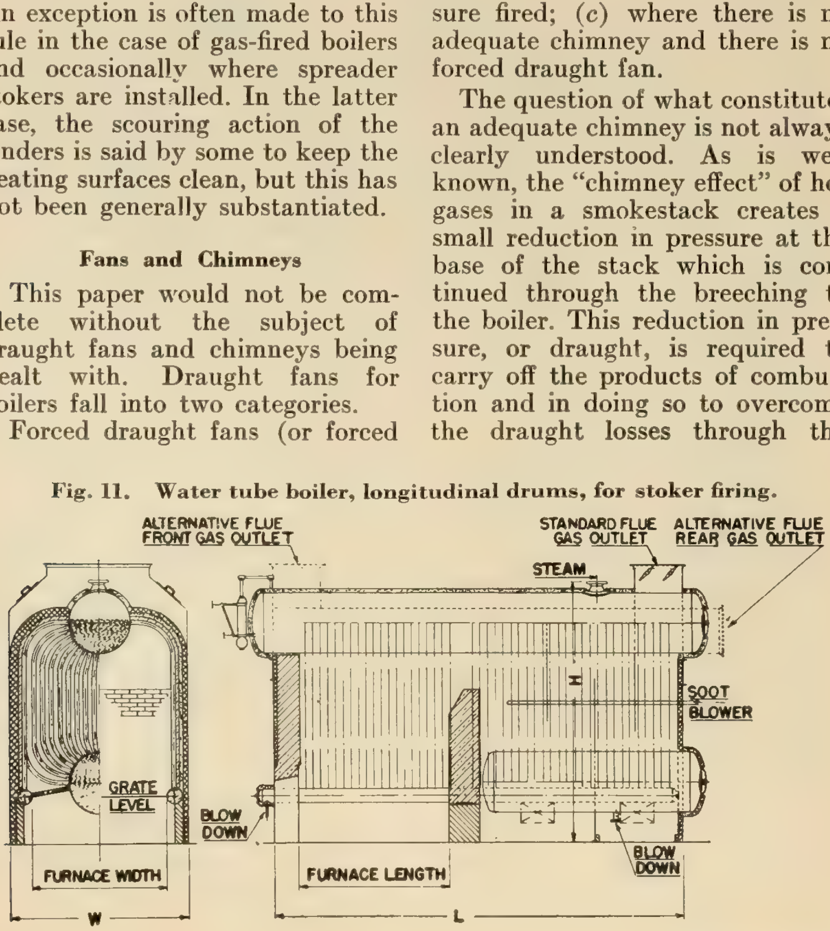
This paper would not be complete without the subject of draught fans and chimneys being dealt with. Draught fans for boilers fall into two categories.

Forced draught fans (or forced air fans) supply the combustion air under pressure to the burners or under the stoker grate. They are, in general, required when conditions are as follows: (*a*) when an air heater is used with the resultant relatively high air pressure loss; (*b*) when a stoker is used with its high fuel bed resistance; (*c*) with gas or oil burners of medium to high capacity where the fan pressure can create better air-fuel mixture by increasing turbulence and hence increase combustion rate and shorten the flame; (*d*) in "package" boilers where only a rudimentary chimney is supplied. These boilers usually operate under pressure from the forced draught fan and hence require to be gastight so that the products of combustion can be forced through the boiler (without leakage into the boiler room) and thence up the chimney.

Induced draught fans, on the other hand, are placed after the boiler and serve to draw off the products of combustion and send them up the chimney. They are essential under the following conditions: (*a*) where air heaters or economizers are installed; (*b*) where there is no adequate chimney and the boiler is not pressure fired; (*c*) where there is no adequate chimney and there is no forced draught fan.

The question of what constitutes an adequate chimney is not always clearly understood. As is well known, the "chimney effect" of hot gases in a smokestack creates a small reduction in pressure at the base of the stack which is continued through the breeching to the boiler. This reduction in pressure, or draught, is required to carry off the products of combustion and in doing so to overcome the draught losses through the boiler. In addition, with a natural draught oil burner, it may have the job of drawing in sufficient combustion air to operate the burner without smoke. The combined requirements may easily be more than the existing or projected stack height can handle and only trouble can ensue if either the stack height or diameter is inadequate.

Fig. 11. Water tube boiler, longitudinal drums, for stoker firing.



It should be borne in mind by the prospective purchaser that just because someone of his acquaintance is "getting by" with a 50 or 60 foot stack does not mean that he also can do so. The draught loss through any given combination of burner, boiler, breeching and stack will vary as the square of the boiler rating. His friend may be operating his boiler at 100 per cent rating, whereas he may need to operate at 150 per cent, thereby requiring a stack two and a quarter times as high.

Other Auxiliaries

It should be noted that there are several other important auxiliaries which the designer must include in his thinking, even if he may not include them all in the specified equipment. A brief list of the more important of these would be:

(*a*) *Feedwater Supply*—required by Code to be in duplicate. If two pumps are used, at least one of them must be steam driven.

(*b*) *Feedwater Treatment*—Consult the experts.

(*c*) *Automatic Combustion Controls*—Highly desirable with rapidly fluctuating loads and essential for unattended boilers.

(*d*) *Indicating and Recording Instruments,* such as steam and airflow recorders, temperature gauges, draught gauges, aid the operator in attaining best efficiency, but may not be economically justified unless substantial quantities of fuel are to be burned yearly.

(*e*) *Automatic Feedwater Regulators*—Essential for unattended boilers and highly desirable for use when loads fluctuate rapidly or boiler water content is relatively small, as in watertube boilers.

(*f*) *Safety Devices* — including flame failure warning and shut-off, air-flow and gas-flow failure fuel cut-off switches. Essential in some form with unattended boilers, and usually specified in conjunction with oil and gas firing in all sizes of boilers. √

PHOTOELASTICITY

. . . for Design Improvement

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Photoelastic stress analysis may provide an answer to stress calculations where these cannot readily be solved by mathematical formulae. The paper outlines the scope and application of photoelastic techniques.

Engineering design involves the calculation of stresses by means of recognized formulae. Occasionally a simple formula such as P/A or M/S does not give the correct value of stress, and in other cases the conditions may be complicated to the extent that no formula is available for stress computation. In situations such as these photoelastic stress analysis may provide the answer, and it is the purpose of this paper to outline something of its scope and application. Figure 1 is the fringe pattern for a short column, loaded in compression, and having a transverse hole 25.2 per cent of the width. Whereas the average stress from P/A is 830 p.s.i. on the reduced section, the 4.7th order fringe at the edge of the hole shows the maximum stress at this section to be 1950 p.s.i. or 2.35 times the average. The photoelastic method has been invaluable in the determination of stress concentration factors.

The photoelastic method for stress analysis is not new. In 1853 a gelatin model was used to investigate torsional shear[1]. A polariscope using glass plates to obtain a wider field was described in 1912 by Coker and Thompson[3]. Photoelastic tests in the plastic range were made in 1923 by Filon and Jessop[4]. A series of papers by Z. Tuzi was published in Japan in the late twenties, reporting work on three-dimensional stress problems, the stress freezing technique, and dynamic stress studies[5,6]. Credit should be given to these men, and others of their times, for the progress that was made in spite of relatively insensitive model materials, polariscopes of restricted size, and a limited background of proven techniques.

The introduction of Polaroid, making possible polariscopes with larger fields, and the development of improved model materials, have greatly expanded the use of photoelasticity since 1930. Many excellent books on the subject are now available [7,8,9,10,11,12] and there have been numerous technical papers. References 13 to 34 indicate the wide field of application for the photoelastic method and are typical of many more problems that have been successfully solved but never published. Figures 2 and 3 are fringe patterns for spur gear teeth showing stresses for one and two pairs of teeth in contact. References 35 to 37 indicate that photoelasticity has been used for twenty years in the study of gear tooth stresses.

Although most of the development of the photoelasticity method has been done in universities many private companies now own and operate polariscopes and are using the technique to analyze stresses for design improvement. A brief summary of the basic principles, together with the latest advances in technique and the difficulties encountered, will serve to show where the photoelastic approach may be used to advantage.

Plane Stress Analysis

To analyze the stresses in a proposed structure an accurately scaled model made of suitable transparent material is used. The model is placed in a beam of polarized light and loaded, in a manner similar to that of the prototype, in a plane perpendicular to the path of light. Strain, induced in the model by the applied load produces temporary birefringence. The entering ray of light, represented as a vector oriented by the plane of polarization, is resolved into components in the directions of the two principal stresses, p and q, at that point. The components travel through the model at different velocities and when recombining on emergence may be in phase, to give a resultant having the original orientation, or antiphased to produce a resultant that represents a 90 degree rotation, or may have a resultant at some intermediate angle. A second polarizer, known as the analyzer, is placed in the light beam beyond the model, either with its axis in line with the first polarizer (forming a "parallel" or "light field" polariscope) or 90 degrees to it ("crossed" or "dark field" polariscope).

The amount by which the emerging vector has been rotated depends on model thickness, material sensitivity, the wavelength of the light, and the algebraic difference of p and q. Rotation of the resultant is indicated by the intensity of light passing through the analyzer. In the crossed polariscope no light is passed in the unstressed regions (hence the term dark field) but as the resultant becomes rotated toward the axis of the analyzer, with increasing load, the light intensity increases at the viewing station. A further increase of load rotates the vector beyond the 90 degree position, until it is again perpendicular to the analyzer axis and the field is again dark. This cycle is known as one retardation and the effect will continue into higher orders as more load is applied. If n is the number of retardations, d the model thickness, and C a constant

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Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

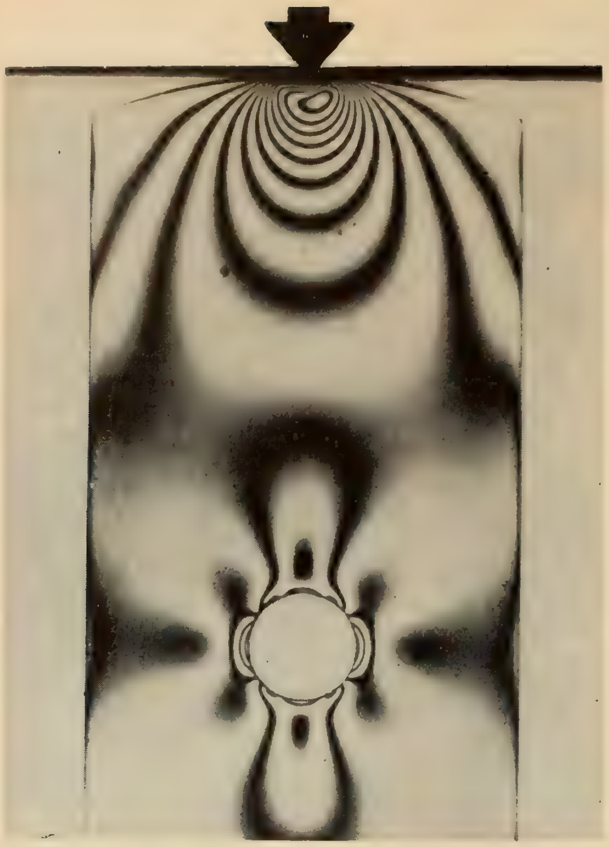


Fig. 1. Fringe pattern for short column, loaded in compression, with transverse hole

for the material sensitivity and the wavelength used, then

$$p - q = n.C/d$$

The value of C is obtained by calibration, using a sample of model material and a known load. The relation between load and retardation number is usually linear up to 10 to 15 retardations.

The variation of $p - q$ throughout the model appears as a pattern of dark and light bands known as fringes and the retardation order is designated by the fringe number. In the light field polariscope the fringes are bright, Fig. 1: in the crossed polariscope the fringes are dark, Fig. 2 and 3. The fringe number at a particular point may be determined when the model is in the polariscope by counting retardations as the load is applied, or on a photograph by counting lines from a point where the fringe order is known, such as the zero fringe at the upper left or right corners of Fig. 1.

When the plane of polarization is in the direction of a principal stress the component perpendicular to it has zero magnitude and hence there can be no retardation effect regardless of how much load is applied. In a model, the points having principal stresses in a given direction will connect into lines known as isoclinics. By rotating the polarizer and analyser, the isoclinics for various stress directions are obtained and these may be used to draw stress trajectories or "flow lines". To make the isoclinics clearly visible, white light is used so that the isoclinic stands out as a black line (in the crossed polariscope) against a coloured fringe pattern.

The coloured fringe pattern results because white light contains all visible wavelengths and the retardation number is affected by wavelength. Above the third order, the coloured bands merge and become indistinct so that monochromatic light, usually from a sodium or mercury vapour lamp, must be used for higher orders. To remove the confusion of superimposed isoclinics, quarter-wave plates are placed between the polarizer and analyzer to produce (and then eliminate) circularly polarized light. Since the directions of principal stresses are not recognized by this light, no isoclinics appear. Figure 4 shows a complete polariscope using a "point" source of light and collimator to provide parallel light through the model. To circumvent the problems of obtaining parallel light over a large area the newer installations utilize a diffused light source, which may be a set of fluorescent tubes closely spaced. The polarizer, analyzer, quarter wave plate and diffused light mat-

Fig. 2. Fringe pattern for spur gear teeth: one pair of teeth in contact.

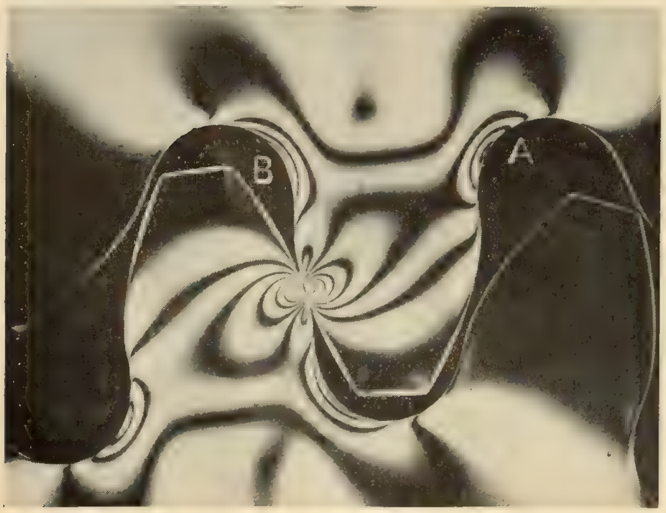
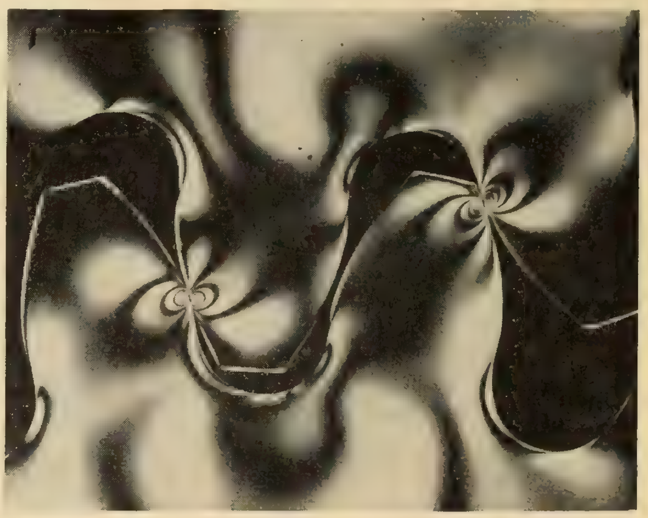


Fig. 3. Fringe pattern for spur gear teeth: two pairs of teeth in contact.



erials, for a 12 inch working area, may be purchased for about $100. To obtain sharp definition throughout the thickness of the model photographs of the fringe pattern are made with a long focal length camera, in some cases a distance of 15 feet between the model and the film, for a 1:1 magnification.

The maximum shear stress at any point is given by $\frac{1}{2}(p-q)$, so that the fringe number can be used to find this stress throughout the model. Components of shear can also be found from $\frac{1}{2}(p-q)\sin 2\theta$ when θ is obtained from the isoclinic. Since failure in a ductile material, under steady load, may start as a shear failure, the photoelastic method gives a direct indication of likely trouble spots.

Maximum tension and compression stresses are not indicated directly by the fringe pattern except at free boundaries, where one of the principal stresses (normal to the boundary) is zero. Since the stress causing failure is likely to be at the surface, no information beyond that given by the fringe pattern is usually required. In fact, where the peak stress can be expressed as a ratio relative to a known stress at some other point, it is not even necessary to calibrate the model material or measure the load that produced the fringe pattern. For example, in the crane hook of Fig. 5 the fringe pattern shows the maximum stress at the inside edge to be four times the stress in the shank and this would be true for any stress intensity within the elastic limit and for any prototype material. It can be shown that the *distribution* of stress within the model is identical with that in the prototype if the shape and load patterns are similar and if the elastic limit is not exceeded. It is also desirable that the optical limit of the model material, i.e. the fringe number for which linearity with stress ceases, be not exceeded. Local excesses of yield or optical limit, say where concentrated loads are applied, may be tolerated without disturbing the general pattern of stress (St. Venant's principle). However, when excessive distortion of the model, due to the low modulus of elasticity possessed by most of the model materials, results in a changed load pattern the stress distributions are no longer comparable with those of the prototype.

When stresses inside the boundary are desired there are several solution methods, although none of these is entirely convenient. If a pattern for $p+q$ could be obtained easily, this, with the fringe pattern for $p-q$ would enable the p and q stresses to be readily determined. Vol. 2 of reference 9 shows how isopachic diagrams for $p+q$ may be obtained experimentally. The Southwell relaxation method[38] is a mathematical means, usually requiring much computation time, in which $p+q$ may be obtained from boundary values found by the photoelastic method. Measurement of the change in model thickness as the load is applied will give $p+q$ but it is a delicate measurement requiring extreme accuracy, and usually can be done for only one point at a time. It is possible under certain special conditions to obtain p and q from photoelastic data, using methods given in Vol. 1 of reference 9. A newer method, developed by Dr. Shelson[39] combines the fringe pattern of the conventional polariscope with those obtained by the scattered light technique, but it is usually confined to the frozen stress models to be described later.

Edge Stress

Accurate determination of the fringe number at a free boundary involves difficulties. In the first place stresses may exist in the model before any load is applied. The materials supplied for photoelastic model-making are usually free of initial stress but if initial stresses do exist they may be determined and suitable compensation made in the assessment of the final fringe pattern. Some materi-

Fig. 4. Complete polariscope using point source and collimator to provide parallel light.

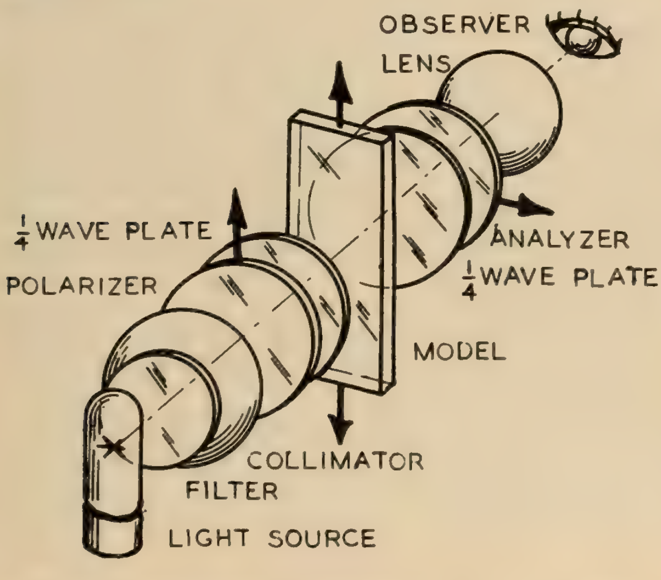
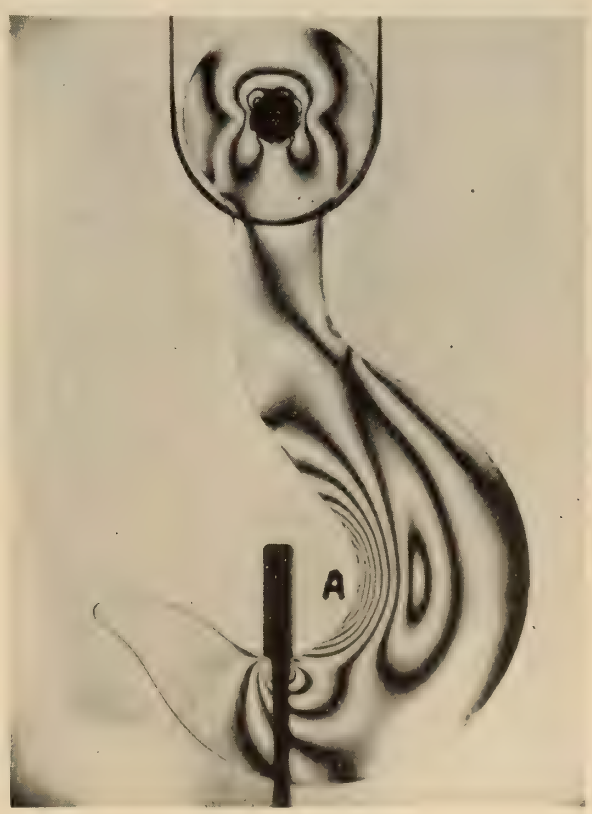


Fig. 5. Fringe pattern in crane hook.



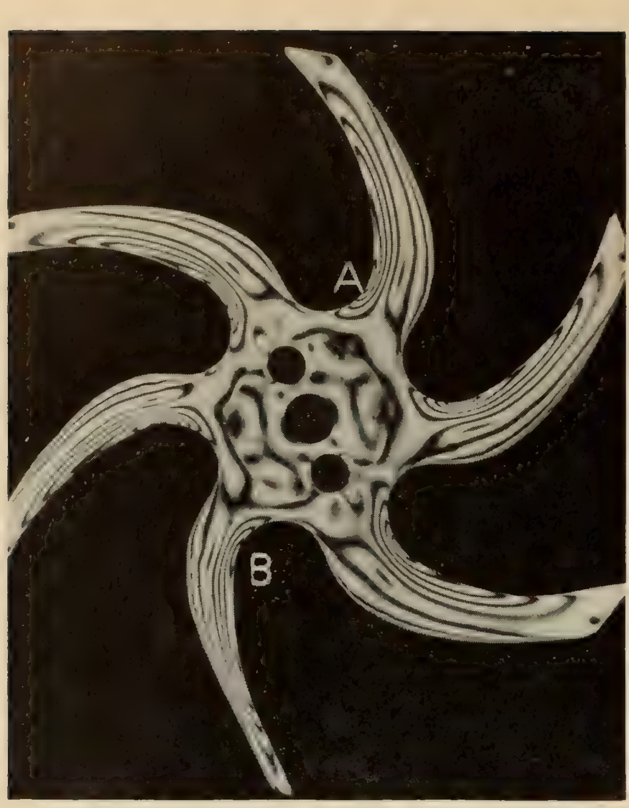


Fig. 6. Fringe pattern for pump impeller.

als permit removal of initial stresses by thermal annealing, although complete removal is somewhat difficult.

Edge stresses may be introduced during machining, particularly if heat is generated because of a dull tool, inadequate cutting clearance, or excessive depth of cut. Models for plane stress problems are usually cut from plastic sheets 3/16 or ¼ inch thick. A modern aid for this work is the Chapman profiler[48]. A high speed tungsten carbide multi-tooth cutter is guided by a follower pin in contact with a ⅛-inch thick metal template, of the correct shape and size, attached by adhesive tape to the plastic being cut. The model can be rough-cut to within 1/16 inch of the template, using a high speed jig saw, leaving only light cuts for the profiler. The presence of edge stress due to machining is evidenced by a disturbance of the fringe pattern. At point A in Fig. 5 the waviness of the fringes close to the edge shows that an uneven machining stress exists. Figure 2 shows the compression fringes in the A region and the tension fringes at B altered at the boundary to indicate the superposition of a tension edge stress. When small holes are required in a model it is usually necessary to have an accurate determination of stress at the edge of the hole, as in Fig. 1. Sharp drills with clean cutting edges will produce stress-free holes, particularly if the drill is submerged in a coolant while cutting.

The second cause of edge stress is an expansion or shrinkage of the machined edges of the model due to absorption or evaporation. This effect is usually uniform throughout the boundary and progresses with time. By using the model soon after it is made the extent of the error is limited. Figure 6 shows a compression edge stress at A and B, superimposed on the tension due to bending and tending to lower the fringe number at the surface.

Creep

Most of the plastics used in photoelastic work exhibit creep at room temperature. At any given point in the model the full strain is not developed the instant that load is applied so that the optical sensitivity appears to increase with time under a steady load. To obtain accurate stress values in a material that creeps, time calibration curves, as in Fig. 7, must be determined and applied to model work by noting the time lapse between initial load application and recording of the fringe pattern. Creep does not affect isoclinic values since these remain the same for all loads.

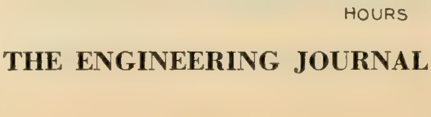
Stress Freezing

Some photoelastic materials will permit a thermal treatment that locks in the stresses, and hence the fringe pattern, after the loads have been removed. The model is heated to 80 to 90 per cent of its critical temperature during a two-hour period, the loads are applied and after about a half hour of "soaking" at constant temperature the model is slowly cooled to room temperature in about twelve hours. The di-phase materials used for this purpose may be visualized as having a fine elastic grid-work or lattice filled with a wax-like plastic that softens with increased temperature and becomes liquid at the critical temperature. The behaviour is fully elastic at the critical temperature but the modulus of elasticity is greatly lowered and hence the optical sensitivity is increased. As the material is cooled, under load, the plastic part stiffens and holds the grid work in the strained position, even when the model is cut into pieces.

If the model is heated to the critical temperature no soaking time is required because there is no longer any creep. However, the distortion is so great that unless the loads are very light the shape of the model may no longer represent that of the prototype. By using 80 to 90 per cent of the critical temperature the distortion is reduced but a soaking period is required to take care of creep, and a calibration specimen must undergo the same treatment if the fringe numbers are to be given a stress value.

Figure 8 shows a suitable oven for stress freezing. A set of heaters, totalling 2000 watts, and a circulating fan provide a steady heat that may be adjusted to any value by means of switches and a Variac. A 20-watt heater and thermostat permit constant temperature control. A variable speed motor drive on the Variac is used to lower the oven temperature slowly and a recording thermometer plots the temperature-time cycle.

Fig. 7. Calibration of CR-39 for creep.



The fringe pattern for the pump impeller shown in Fig. 6 was obtained by rotating the model at 3200 r.p.m. while the temperature was brought up to 210° F., held for half an hour, and then lowered over a 15-hour period. The photograph of the fringes was made in a conventional polariscope, and shows the largest stress to be tension at the inside fillet. Several blade shapes were included in the one model and it is interesting to note that the thinner blade at B shows one less fringe than the thick blade at A.

When dynamic stresses have "fixed" values, as in the rotating impeller, the stress freezing technique is suitable for stress evaluation but it is of no use for fluctuating stresses. In one of the impeller models that was tested the blades vibrated during rotation and the areas in which there were fluctuating stresses showed no distinct pattern. For problems of this kind and for stresses due to impact, a very strong light source of short duration is required. Figure 9 shows the Model 1534-A Polariscope[64] in which the Strobolume is used as a light source. With this equipment fringe patterns of a beam vibrating at 30 c.p.s. may be obtained, as described in references 40 and 41.

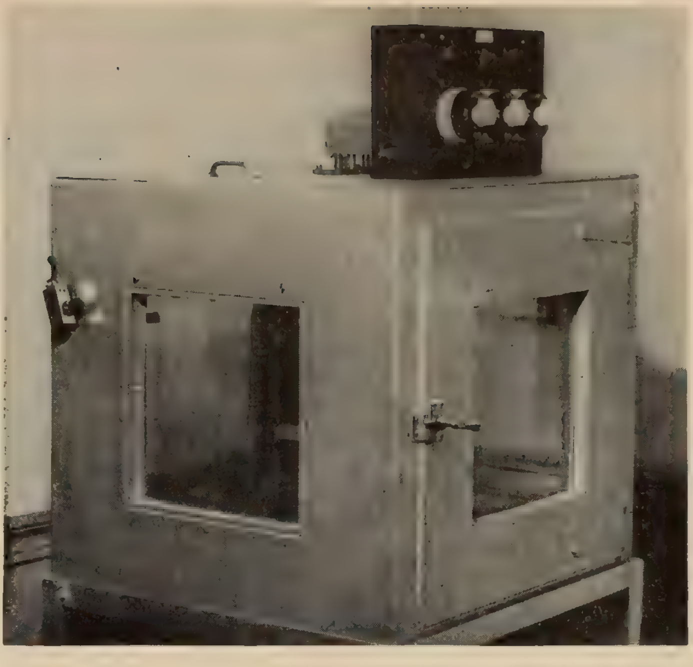


Fig. 8. Oven suitable for stress freezing. Constant temperature control is incorporated.

Materials

For plane stress models, CR-39 plastic[65] is most convenient. It is supplied in sheets of various thicknesses, 3/16 and ¼ inch being most useful, with optically polished surfaces. Although it cannot be annealed, it is usually free of stress when supplied and if machined carefully a stress-free model is obtained. Account must be taken of creep and time edge stress.

Celluloid, Lucite, and Plexiglas, although readily available and low in cost, are too insensitive optically for use as photoelastic models. This is illustrated in Fig. 5, where the model is made of CR-39 but the loading link at the top is Lucite of thickness equal to that of the model. No fringes appear in the loading link but those in the eye of the hook are readily visible.

BT-61-893 was the designation[66] of a material developed by another company for photoelastic work but it is now known as Catalin 61-893. It is supplied in sheets up to 1⅛ inch thick and is readily machined. The faces of a sheet are rough-sawn and it is necessary either to polish a model to optical clarity or coat it with an oil, of the same refractive index, while viewing the fringes. Catalin 61-893 can be annealed and is suitable for stress freezing, with a critical temperature of 230° F., but it develops severe time edge stress as can be seen in Fig. 6.

Other materials such as Catalin 800, Marblette, Marco Resin, and Castolite may be used. For problems in which the body force (weight) is large relative to any externally applied load, such as in the study of earth dams and underground tunnels, gelatin is used. References 43 to 47 discuss materials.

Polariscopes

There are a number of commercial polariscopes available, ranging in price from $600 to $5000. References 41 and 48 to 51 list some sources of supply for polariscopes and one deluxe "home made" model.

The optics for a polariscope are usually purchased although the means for rotating the polaroids by remote control might be constructed by the user. The loading frame should be arranged for controlled application of load by a remote means so that the fringe build-up can be watched. There should also be an arrangement for bringing any point on a loaded model to the optical axis of the polariscope, preferably by controls at the viewing station.

The loading frame for the polariscope used in the Department of Mechanical Engineering at the University of Toronto has a screw thread arrangement giving coarse adjustment for tension, compression, and bending loads, a short stroke hydraulic piston for actual (remote) load application, and a strain gauge dynamometer system that measures only the load applied to the model. It permits a total force of 750 lb. with scale divisions of ½ lb. The loading frame (and model) can be moved horizontally and vertically, by handwheels located at the viewing station, for positioning of the model in the field.

Three Dimensional Stress Analysis

When the loads applied to a flat model are in the plane of the model the significant stresses will also be in that plane, although perpendicular stresses will exist. If the model is thin relative to its general dimensions the principal stresses will remain constant along the path of the light and the fringe pattern will be a true representation of the state of stress. However, if the model has excessive thickness, or if the loads do not lie in one plane, the value of $p-q$ may change along the light path and only an average value is indicated in the fringe pattern. Furthermore, with three dimensional loading the directions of the principal stress planes will vary throughout the body.

On a plane of symmetry in a body the principal stresses must lie in the plane and perpendicular to it. Hence, if this plane is isol-

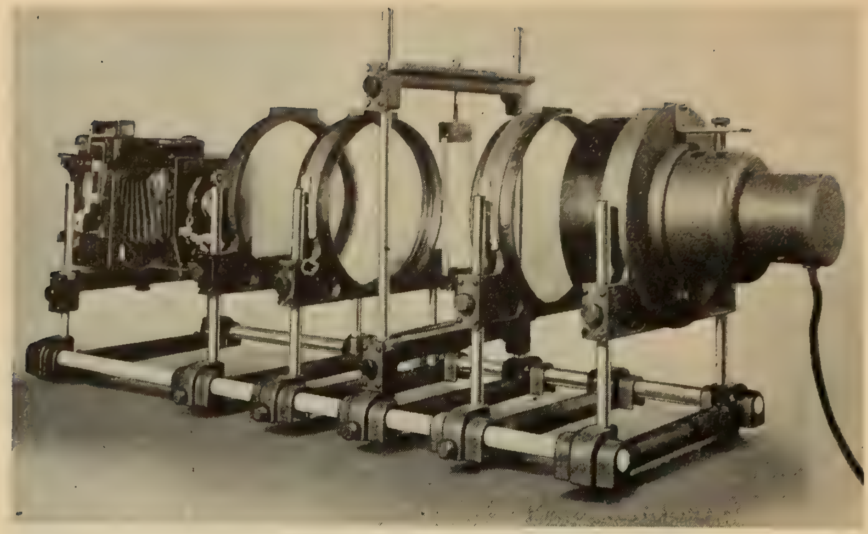


Fig. 9. Polariscope using the Strobolume as light source. Fringe patterns of a beam vibrating at 30 c.p.s. may be obtained. *(Photo.: General Radio Co.)*

ated, it can be examined in a conventional polariscope with the assurance that the observed fringes represent the differences of true principal stresses — those in the plane of symmetry. The principal stresses normal to the plane will not affect the fringe formation and some other approach is required to determine them.

At the surface of a body where no external load is applied one of the principal stresses is zero and the other two are in the surface plane. Again, if this plane could be isolated and examined in the conventional way, the principal stresses would be obtained.

One technique for examining the stresses in a plane using the conventional polariscope is to "freeze" the stresses as described previously and then saw the plane, as a slice, from the model. If the usual machining care is taken to prevent the introduction of machining stress, the frozen stresses will be unchanged by the slicing. A compromise must be made on the thickness of slice taken, since the fringe orders are reduced when the slice is made thinner, so as more nearly to approach uniform conditions in the perpendicular direction. If reduced forces are used to control distortion during stress freezing the highest fringe order in the slice may be only one or two.

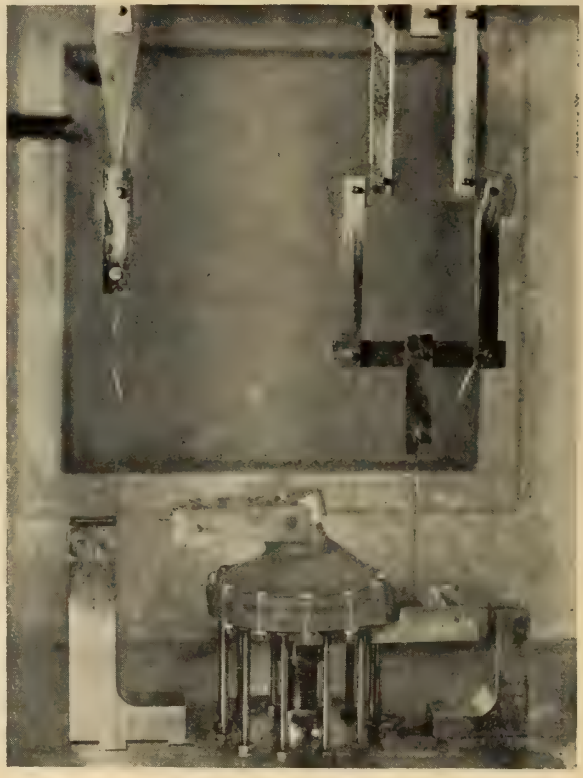
A superior material[67] for the stress freezing technique is known as Fosterite. It has a high optical sensitivity, a lack of time edge stress, and is available in cylinders up to 6 inches diameter. The critical temperature is 194° F. so that a minimum freezing temperature of 160° F. is suitable. The University of Toronto oven, which measures 2 x 2 x 2 feet, requires about 200 watts for this temperature. The properties of Fosterite are outlined in references 51 and 52 and summarized in Table I.

Figure 10 shows a Fosterite model in the oven after stress freezing. The model consists of a hub and a flange, joined by a conical web section. With the flange securely bolted, a couple was applied to the hub in the form of horizontal forces acting through wires attached to the hub, passing over ball bearing pulleys and to which weights were attached. Because of the high coefficient of expansion for Fosterite (200×10^{-6} in./in./°C.) the flange was bolted to a Fosterite ring that was supported on thin steel rods to permit free radial movement of the ring. A Fosterite disc bolted to the jig and given the stress freezing cycle showed no stress induced by thermal effects.

The load applied to this model was too high and excessive distortion resulted. A slice from the plane of symmetry, Fig. 11*a*, shows a fringe order of 19 at the outside web fillet. In subsequent tests the load was reduced to keep the maximum fringe number below 10. Figure 11*b* is the same slice photographed 16 months later, showing the lack of time edge stress and no change in the fringe orders.

The slices were carefully sawed from the model and then faced in a lathe, using light cuts with the slice attached to the face plate by double adhesive. No polishing was done, but the slice was placed in a plate glass tank filled with oil of the same refractive index for viewing. In subsequent tests in this project the conical web was pierced with small holes and special techniques were used to obtain the stresses adjacent to

Fig. 10. Fosterite model (hub and flange joined by a conical web section) in the oven after stress freezing.



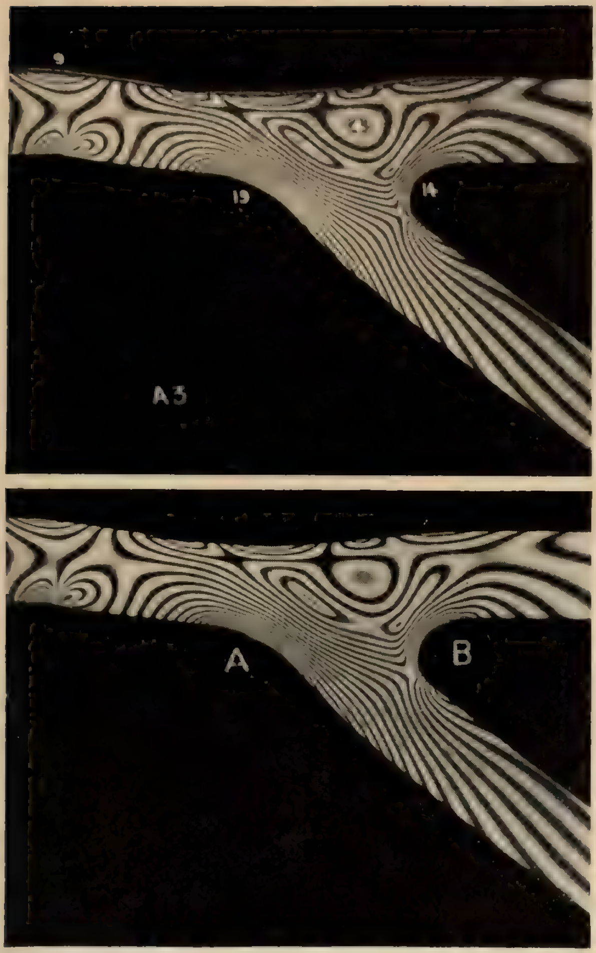
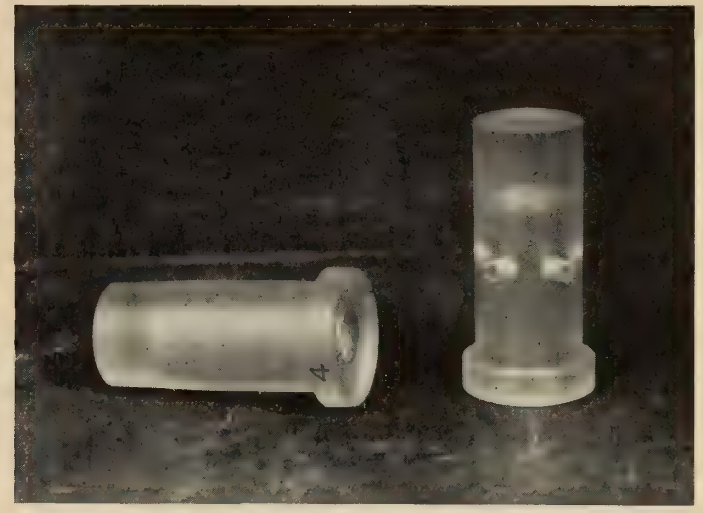


Fig. 11 (left). Slice from the plane of symmetry of the model shown in Fig. 10 showing excessive distortion; (*a*) above, original photograph; (*b*) same slice photographed 16 months later.

Fig. 12 (below). Two Fosterite models used in an analysis of stresses in thick-walled tubes.



them, but the maximum stress occurred at the hub fillet.

Scattered Light Technique

The problem of examining stresses on a plane can in some cases be handled by the scattered light technique in which a sheet of light is passed through the model instead of actually slicing it[54,55,56]. The light excites the particles of the plastic model so that they become secondary sources of light, of greatly reduced intensity, and may be viewed in a direction perpendicular to the beam. The effect is strongest where the light enters the model and diminishes along its path, particularly after passing through a region of high stress. Using a sheet of plane polarized light, preferably set at 45 degrees from the planes of principal stress, interference due to birefringence takes place along the path of light and a series of fringes may be observed indicating stress intensity not by fringe order but by fringe spacing. For each retardation the stress intensity is obtained from the fringe spacing d and material constant C as follows:

$$p - q = C/d$$

As the value of $p - q$ increases, the fringe spacing d decreases.

To prevent reflection and refraction at the model boundary it is submerged in a mixture of Halowax and Bayol, compounded to give the same index of refraction as the model material. A high intensity monochromatic light source is used with a polarizer, and a 0.010-inch slit provides the sheet of light. As the intensity of the scattered light is very low a completely darkened room must be used and a photographic exposure of 10 minutes is required with Super Pancro-Press Type B film. Measurement of fringe spacing must be accurately done and for this purpose the University of Toronto Photoelastic Laboratory has a microphotometer that measures light intensity on a spot 0.003-inch diameter. As the photographic film of the fringe pattern is moved with micrometer precision past the eye of the photometer a meter shows the exact centre of the dark fringe. The phototube is so sensitive that it must not be exposed to the bright part of the fringe pattern.

Figure 12 shows two of the Fosterite models used in an analysis of stresses in thick-walled tubes, subjected to axial load and internal pressure, with and without transverse holes. The study was made in connection with the gas

Table I. Properties of Materials Used for Models.

Material	Temp. °F.	Sensitivity p.s.i. per fringe	E p.s.i.	Poisson's Ratio	Creep	Time edge stress
CR-39	Room	75–90	295,000	0.41	medium	small
Catalin 800	Room	45–50	187,000	0.40		medium
	176	1.6	1,500			
BT-61-893	Room	84	630,000	0.36		large
	230	3.2	1,150	0.50		large
Fosterite	Room	unsuitable			high	none
	185	3.6	2,300	0.48	none	

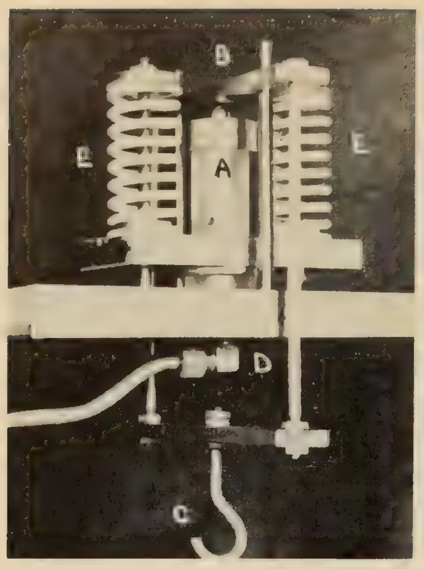


Fig. 13. Model (A) in loading frame ready for stress freezing: (B) frame for applying axial load; (C) hook for weights; (D) connector for internal pressure; (E) springs holding flange of model against bottom plate.

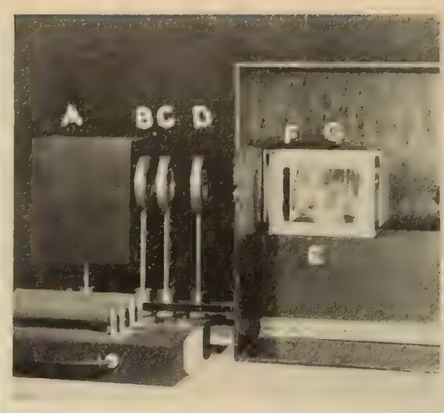


Fig. 14. Model in scattered light polariscope. A, mercury vapour lamp; B, filter; C, collimator; D, polarizer; E, plate glass tank; F, metal slit; G, model in special holder.

tube of an automatic shell ejector[57]. Figure 13 shows the model (A) in the loading frame ready for stress freezing; B is the frame for applying axial load through hook C and attached weight, D is the connection for internal pressure, and E the springs that hold the flange of the model against the bottom plate. A rubber membrane arrangement prevented loss of the hydraulic oil through the perforations, while offering no appreciable restraint on the internal pressure. Figure 14 shows the model in the scattered light polariscope. The letters indicate the high intensity mercury vapour lamp at A, a filter at B, collimating lens at C, polarizer at D, plate glass tank (before filling with Halowax mixture) at E, metal slit at F, and the model in its special holder at G. Fringe patterns were photographed from approximately the same point used to take Fig. 14.

Figure 15a is a scattered light fringe pattern for a transverse plane cutting through the unperforated tube shown at the left in Fig. 12. The tube has not been cut apart in any way, but it does not show in Fig. 15a because it is illuminated only on the transverse plane, the light entering from the left. The pattern frozen in the model resulted from internal pressure and axial load. The fringe *spacing* along the horizontal diameter represents the difference between the axial stress and the tangential stress. An increase in stress intensity toward the inside of the tube is plainly visible. By using other optical sections the three stresses, axial, radial, and tangential, may be found. Figure 15b is a transverse section that was taken tangent to one side of the perforations. Although the holes are not visible in the photograph their effect on the fringe pattern may be clearly seen.

Oblique Incidence

When examining a slice, or a plane stress model, in the transmission polariscope care is usually taken to have all rays in the beam of light perpendicular to the face of the slice. However, for determination of stresses at a given point it is possible to rotate the slice about one of the principal stresses at that point and obtain a new fringe value[58,59]. The method is more difficult and in some cases not applicable for slices that are not from a plane of symmetry, but may be used for boundary stresses, particularly when the directions of principal stresses are known before slicing[60].

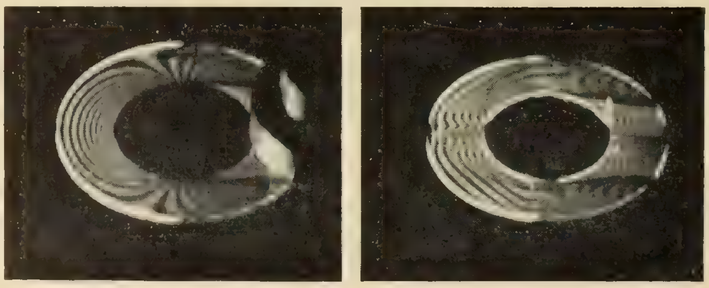
Conclusion

A number of photoelastic techniques have been described briefly and it may be necessary in a complicated stress problem to use a combination of these together with information from the applications of stress coat or strain gauges to a metal model. With careful work and straightforward techniques an accuracy within 5 per cent may be obtained but under questionable conditions the error might be 30 per cent[61]. However, in the latter case it frequently happens that there might be no alternative approach to the stress problem and the photoelastic method is infinitely better than none.

In plane stress work there is no effect on the similarity of stress distribution between model and prototype arising from differences in Poisson's ratio. In three dimensional work, however, these differences have a definite, although usually unknown, effect. In the stress freezing technique the plastics attain a ratio of 0.5 which is significantly different from that of metals, so that attempts have been made to develop three-dimensional room - temperature procedures[62]. However, in the discussion by V. M. Hickson of reference 61, it is pointed out that errors caused by differences in Poisson's ratio are not as significant in the maximum principal stress as in the lesser ones, and that some interpolation might be done between models made of materials having different values of the ratio if the effect became important.

Fortunately many problems can be treated with sufficient accuracy using CR-39 plastic in a transmission polariscope and the speed of this method makes it attractive. In the problem of the gas tube for the automatic ejector it was desirable to have the maximum amount of perforation, for gas discharge, without increasing stress concentration unduly. For this study the tube was considered as a flat plate,

Fig. 15. (a) Left, scattered light fringe pattern for transverse plane through unperforated tube. (b) Pattern for transverse section tangent to one side of perforations in tube.



loaded in compression, with various arrangements of holes in-line and staggered[63]. Figure 16 shows a plate carrying a vertical compression load while Fig. 17 and 18 are enlargements of the in-line and staggered arrangements.

The results of this investigation showed the stress concentration factor for the in-line arrangement remained at about 1.65 as the ratio of hole area to net area increased (closer hole spacing) while the factor for the staggered arrangement rapidly increased with increase of area ratio beyond 0.30.

In the measurement of loads, dynamometer rings are frequently used, with strain gauges cemented on the inside and outside of a metal ring. Since the strain gauge measures the average strain over the area to which it is applied, it is of interest to know the stress gradient along the external and internal surfaces of the ring and if the stress changes sign. The inside and outside gauges are usually connected into opposite arms of a Wheatstone bridge, so that the ratio of average stresses should be known. When the dynamometer ring is small, say two inches outside diameter, it is necessary to know whether a more expensive short gauge should be used or the conventional A-11. Accurate calculation of these stresses is quite tedious but the polariscope provides a very convenient method.

Sometimes stresses exist that are unsuspected until failures begin to appear. For example, there is a surface tension stress adjacent to a large compression contact stress. This stress was the cause of fatigue failures in railroad axles where the car wheels were shrunk to the shaft, until a combination of redesign and artificially induced surface compression stress eliminated the trouble. The tension stress was demonstrated photoelastically by a frozen stress model in reference 39, but it is also shown in Fig. 19, using a plane compression load on CR-39. The 1.8 order fringe at A represents a tension stress of 790 p.s.i. developed by the (average) 2140 p.s.i. compression stress at the contacting surface.

Many stress problems remain that cannot be solved by the photoelastic method; some of these may never attain solution, others await the ingenuity of the photoelastician to devise new or improved techniques. From the examples included in this paper and those given in the bibliography it is evident that in many instances photoelasticity can be of great assistance to the design engineer and that the day is not far off when the polariscope will be a necessary tool, not a luxury.

(***DISCUSSION**—see page 34*)

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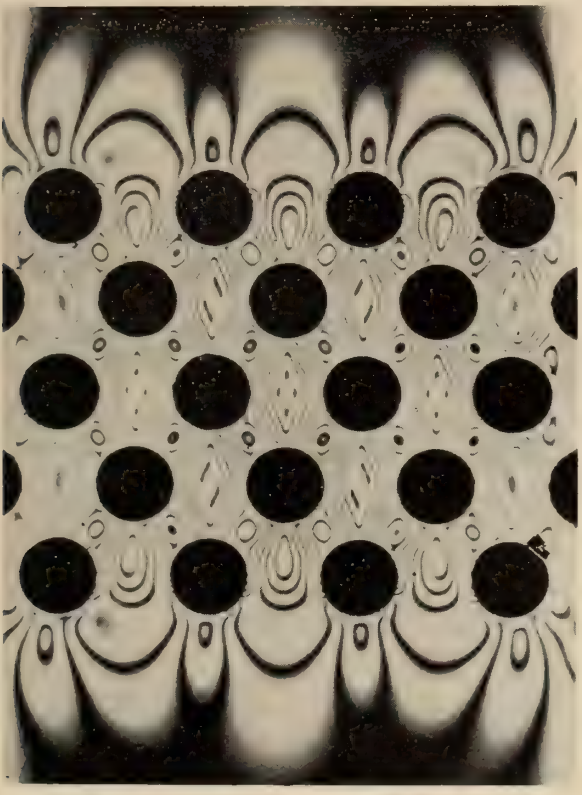

Fig. 16 (left). Plate carrying a vertical compression load.

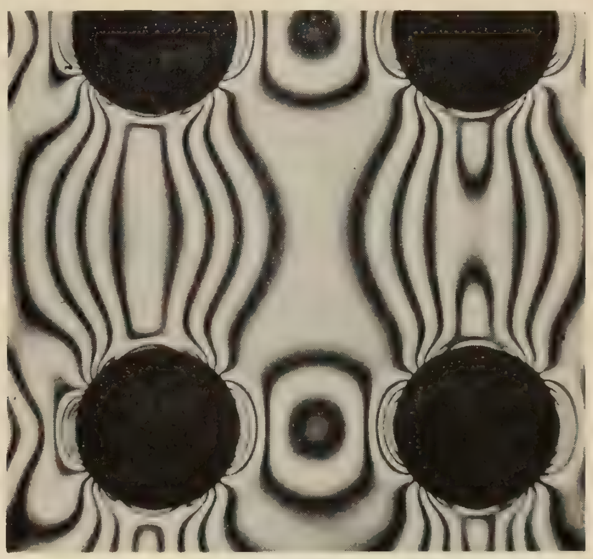

Fig. 17 (top, right). Enlargement of in-line arrangements from plate carrying vertical compression load.

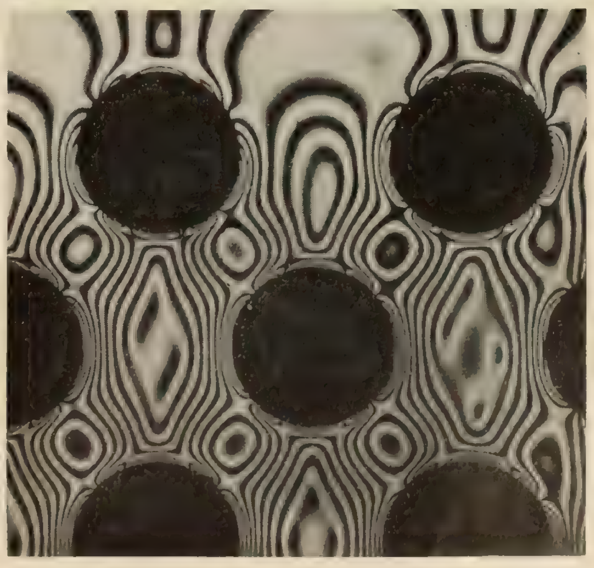

Fig. 18. Enlargement of staggered arrangements from Fig. 16.

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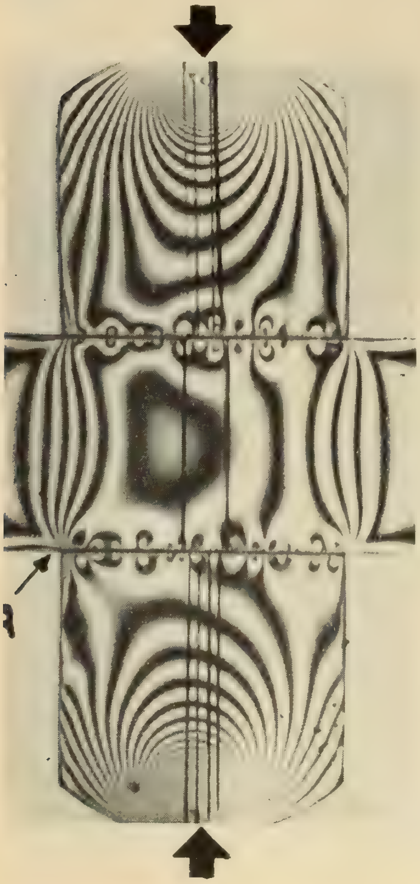
Fig. 19. Tension stress existing adjacent to large compressing contact stress.



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A Complete Sanitation Program for Metropolitan Toronto

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Municipality of Metropolitan Toronto.

Following the establishment of a metropolitan form of government in the Greater Toronto area a master plan was developed to provide adequate water and drainage facilities throughout this area of rapid growth.

In recent years industrial and residential expansion in the metropolitan Toronto area has been spectacular, perhaps as rapid as any city in North America. Since the war, the population of Toronto and its twelve surrounding municipalities has shown an intense growth — from 900,000 to over 1,250,000. Of this increase, very little has occurred within the city proper, but the population of some of the suburban municipalities has more than doubled. For instance, the population of the township of North York increased from 38,000 in 1948 to over 130,000 in March, 1955. The growth in population of the suburban municipalities shows no sign of abating.

Coincident with the rapid expansion of the Toronto area has come a tremendous demand for services of all types, which was one of the compelling reasons necessitating the establishment of a metropolitan form of government in the Greater Toronto area. Paramount in the service requirements was a demand for sewage disposal facilities which it had been demonstrated could not be provided by the individual efforts of the separate municipalities or by reliance upon the process of mutual assistance and cooperation.

The city of Toronto, for example, supplied sewage treatment facilities for the village of Forest Hill and the town of Leaside, and accepted some sanitary drainage from the townships of North York, York and East York, all of whom paid trunk sewer and outlet charges for the accommodation provided. The township of Etobicoke had agreements with the town of Weston, the village of Long Branch, and the Union Sewerage Commission (Mimico and New Toronto) for treatment of sanitary drainage. With the tremendous increase in population in the townships of Etobicoke, Scarborough and North York, shortage of water and sewerage accommodation in these municipalities was particularly severe. At this time the city and the municipalities through agreements endeavoured to give sewer and water accommodation within their ability to cope with the situation.

The problems presented by the above-mentioned conditions, among others, finally became acute and required an immediate remedy. Realizing the problem the city made application to the Ontario Municipal Board for amalgamation of the twelve adjoining suburban municipalities and itself. After a complete and exhaustive investigation of existing conditions the Ontario Municipal Board, in a report signed by its chairman, Lorne Cumming, and its vice-chairman, W. J. Moore, placed its findings and recommendations before the Government of Ontario. These recommendations were used by the Provincial Government as the basis of "Bill 80", which, after receiving Royal assent on April 2, 1953, became "The Municipality of Metropolitan Toronto Act."

The local municipalities which together constitute the new municipality of metropolitan Toronto are shown in Fig. 1 and listed in Table I.

The Municipality of Metropolitan Toronto Act provided that on and after January 1, 1954, responsibility for all sewage treatment within the metropolitan area rested with the new metropolitan corporation, and no member municipality would be permitted after that date to operate, plan, or own any sewage treatment works.

To enable the new corporation to meet its obligations under the act, it additionally provided that, on the date mentioned, all rights and titles to sewage treatment works, sewage pumping stations, and trunk sewers owned by area municipalities or boards thereof, and designated by by-law of the metropolitan council, were to be transferred to the municipality of metropolitan Toronto, which, along with the physical structures, assumed all outstanding debt, and all rights or obligations imparted by existing agreements, easements, etc.

One of the first steps taken by the new administration was the engagement of a firm of consulting engineers to present recommendations for a master plan to provide the much needed water and drainage facilities throughout the metropolitan area, in as orderly a fashion as possible, and in a manner that would keep the works program within the financial ability of the metropolitan corporation. On January 30, 1954, the firm of Gore and Storrie presented its report to the metropolitan works committee, which forwarded it to the metropolitan council, embodying a priority list for the works as recommended by the commissioner of works.

Existing System

Most of the existing sewers in the metropolitan area are of the

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Read at the 69th Annual General and Professional Meeting of The Engineering Institute of Canada, Toronto, May 1955.

combined type, in which the sanitary and industrial wastes and surface water are collected and carried away together in the same sewers. The construction of sewers of sufficient capacity to carry the combined storm and sanitary flow to a single point of disposal is not economically feasible and, consequently, the usual practice is to convey an amount equal to 2½ times the normal dry weather flow to the sewage treatment plant, and to discharge the remainder of the flow to nearby watercourses or lakes.

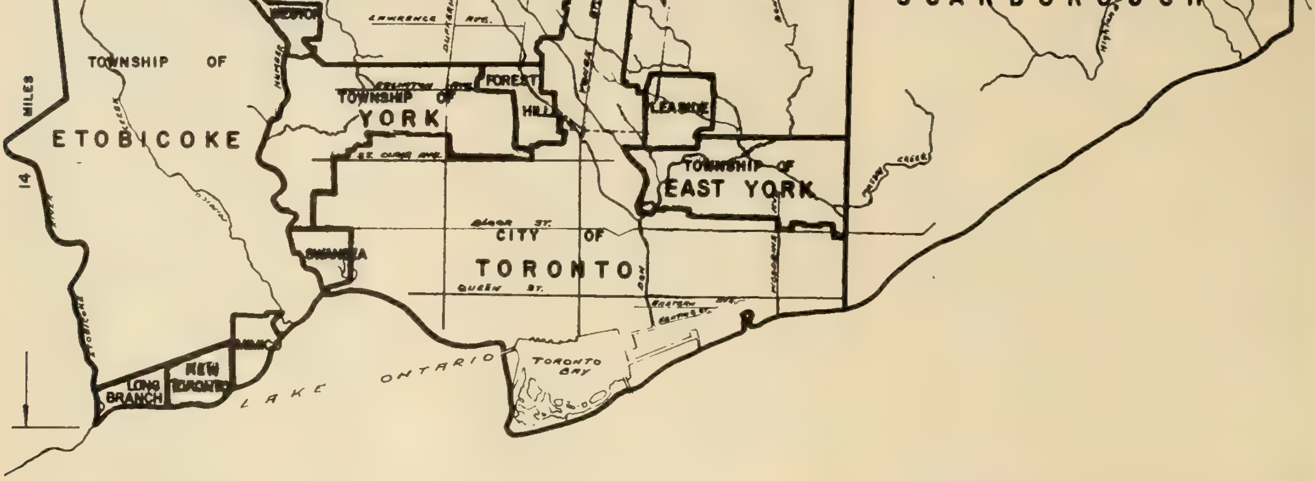
In metropolitan Toronto there are many watercourses into which storm flow may be discharged without nuisance, but many of them are so small that the overflow from a combined sewer system would be objectionable because of pollution carried into the streams during such overflow periods. Accordingly, metropolitan Toronto has adopted the policy that in the future all sewers in the area will be separate, i.e., sanitary sewage is carried in one set of sewers and storm water runoff in another. Coupled with the resulting improvement in stream conditions will be the saving in the size of sewage treatment plant facilities, with the elimination of the extra 150 per cent load delivered to the plants by combined sewers designed to intercept 2½-times dry weather flow.

Table I. Municipalities Constituting Metropolitan Toronto

Municipality	Area Acres	Area Sq. Miles	Population March, 1955
City of Toronto	22,287	34.82	682,415
Township of York	5,050	7.89	106,695
Township of East York	3,747	5.85	68,812
Township of North York	44,588	69.65	130,766
Township of Scarborough	45,012	70.33	95,706
Township of Etobicoke	27,312	42.67	83,169
Town of New Toronto	659	1.02	11,207
Town of Mimico	500	.78	12,383
Town of Leaside	1,126	1.75	16,873
Town of Weston	622	.97	8,569
Village of Forest Hill	739	1.15	18,664
Village of Swansea	682	1.06	8,718
Village of Long Branch	750	1.17	9,263
Totals	153,074	239.11	1,251,840

Prior to formation of the metropolitan corporation, proper engineering design of sewer systems was, in many cases, not possible because of artificial municipal boundaries. Where joint services were required, neighbouring municipalities often could not find a basis for determination of responsibility; down-stream communities, whose treatment facilities already were inadequate or overloaded, were obliged to refuse sanitary drainage from their up-stream neighbours and sewers in areas which provided natural outlets for storm drainage from up-stream communities were inadequate to serve the neighbour, so that some up-stream areas bordering heavily developed sections down-stream became virtually impossible to drain from an economic standpoint. In short, no long-range view was possible and the end result is the existence of a non-integrated system; sewers in one municipality draining large areas toward another municipality, and into which they logically should continue to flow, instead are intercepted by pumping stations, or a series of pumping stations, which pump the flow back, often by long and complicated systems, to a sewage treatment plant upstream. In many cases the plant effluent then flows back in an open stream often through the municipality which originally refused to accept the sewage. This condition cannot be corrected immediately but will gradually be improved with the construction of a metropolitan sys-

Fig. 1. Municipal boundaries of Metropolitan Toronto.



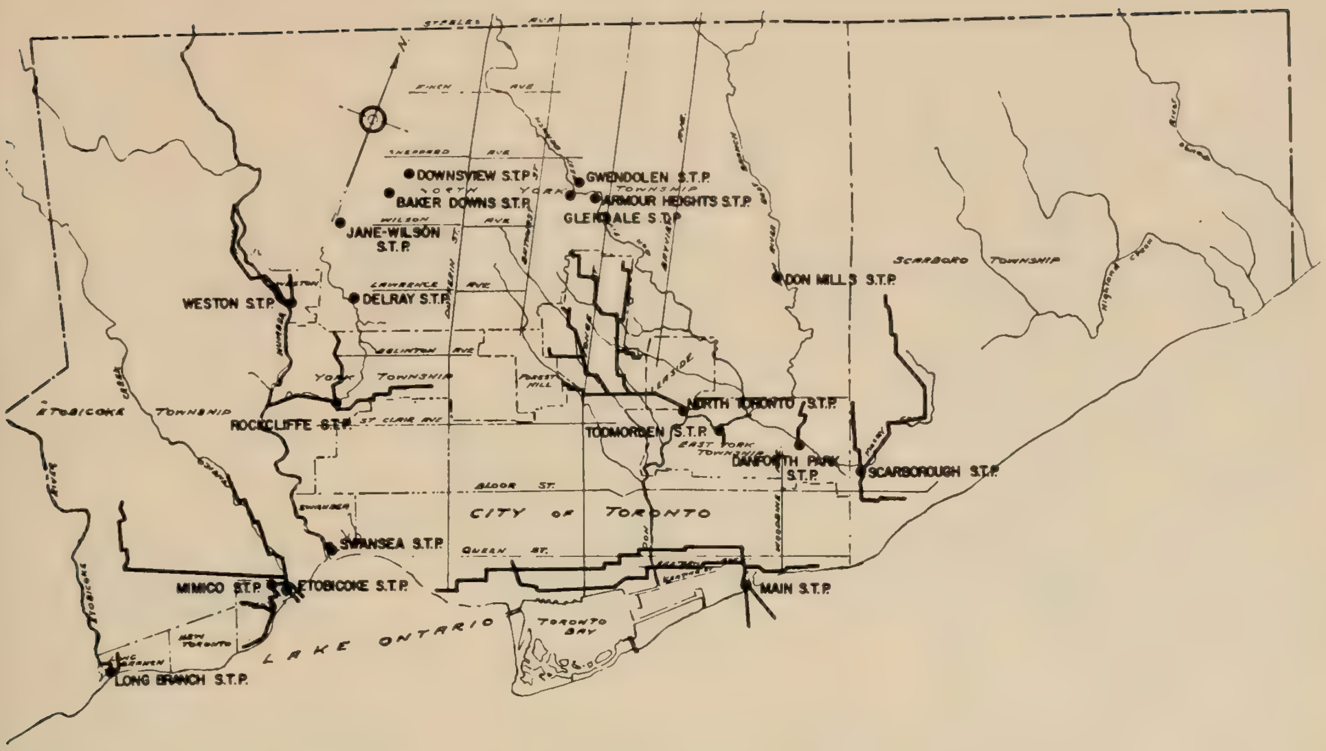


Fig. 2. Existing trunk sewers and sewage treatment plants.

tem designed to serve all areas with equal and adequate facilities.

Existing Sewage Treatment Plants

There are nineteen sewage treatment plants within the borders of metropolitan Toronto, as indicated in Fig. 2. A list of these plants is given in Table II.

The foregoing plants, with the exception of the R.C.A.F. plant at Downsview, and the Don Mills plant, were assumed by Metropolitan Toronto By-Law No. 36 on January 1, 1954, as authorized by the Municipality of Metropolitan Toronto Act. The other two plants were not assumed as they were not owned by an area municipality at the time the by-law was passed.

All of the above-mentioned treatment plants, with the exception of Weston, are of the activated-sludge type, the latter being a bio-filtration installation. The main plant, at the moment, provides primary sewage treatment only, with the second stage, i.e., installation of aeration tanks, secondary settling tanks, etc., at present under design.

Sewage may be broadly defined as "water-carried wastes", and its character depends upon the relative amount of water and the composition of wastes. Wastes from residential and commercial areas do not vary a great deal in composition or in quantity per capita. Wastes from industrial establishments, however, may vary a great deal.

Sewage treatment consists essentially of the removal of the wastes from the sewage so that its water content, which is used as the carrier of the wastes, can be safely discharged into the receiving waters. There are numerous processes involved in the treatment of sewage, and the degree of treatment to be accomplished depends upon the processes or the combination of processes utilized. Primary treatment consists of the removal of the heavier solids from the sewage, usually by means of screening, settling of grit, and sedimentation. Secondary treatment consists of the removal of the finer solids and colloidal matter and is generally accomplished by means of a bacteriological process involving oxidation and sedimentation. Treatment plants of the primary type remove 50 to 55 per cent of the suspended solids and about 35 per cent of the biochemical oxygen demand. Secondary treatment plants can accomplish reductions of 90 per cent or more.

In addition to the treatment of the sewage to provide a good effluent for discharge into the lake or stream, provision must be made for the disposal of the wastes as they are removed from the sewage. The first step is usually anaerobic digestion in heated tanks which reduces the solids by 45 to

Table II. Sewage Treatment Plants in Metropolitan Toronto

Name of Plant	Capacity (M.g.d.)	Constructed by	Location
Main (Ashbridge's Bay)	84. (D.W.F.) 210. (Storm)	City of Toronto	Ashbridge's Bay
North Toronto	7.5	City of Toronto	Don River
Glendale	3.0	North York Twp.	West Don River
Armour Heights	0.24	North York Twp.	West Don River
Gwendolyn	0.15	North York Twp.	West Don River
Don Mills	1.4	North York Twp.	East Don River
Jane-Wilson	0.15	North York Twp.	Black Creek
Baker Downs	0.42	North York Twp.	Black Creek
Delray	0.75	North York Twp.	Black Creek
Downsview	0.75	R.C.A.F.	Black Creek
Weston	2.7	Weston	Humber River
Rockcliffe	2.5	York Twp.	Black Creek
Swansea	0.5	Swansea	Humber River
Etobicoke	3.0	Etobicoke Twp.	Mimico Creek
Mimico	2.4	Mimico	Mimico Creek
Long Branch	0.75	Long Branch	Etobicoke Creek
Todmorden	1.5	East York Twp.	Massey Creek
Danforth Park	1.0	East York Twp.	Massey Creek
Pharmacy Avenue	2.25	Scarborough Twp.	Massey Creek

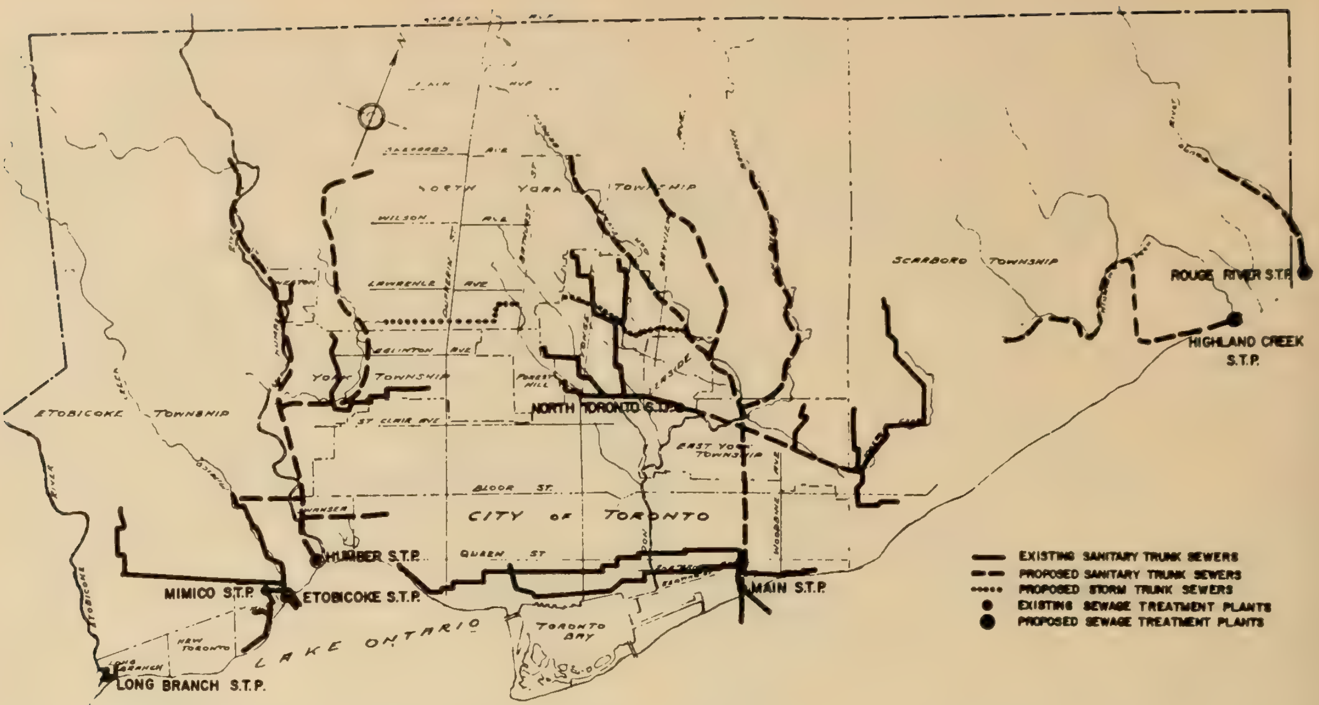


Fig. 3. Ultimate trunk sewers and sewage treatment plants.

50 per cent. The digested sludge can then be dewatered on vacuum filters, heat dried and disposed of as a fertilizer, or burned.

A treatment plant with secondary treatment to serve a population of one million persons will produce daily about 2,500 tons of raw sludge, 1,250 tons of digested sludge, 500 tons of sludge as dewatered on vacuum filters, 135 tons if heat dried, or, if burned, 25 tons of ash. It is quite apparent that the volume of wet sludge, even if digested, is great and if not hauled to farms and deposited on the land, requires that drying or incineration facilities be provided. The main sewage treatment plant at Ashbridge's Bay has facilities for either burning or heat drying the sludge.

The provision of complete treatment of the sewage to remove 95 per cent or more of the suspended solids and biochemical oxygen demand, together with chlorination of the effluent is planned for the main treatment plants to serve the metropolitan area.

The construction of eight treatment plants in the township of North York, as listed in Table II, scattered as they are over an area approximately double that of the city of Toronto, has served a useful purpose, but does not constitute a permanent solution for the disposal of sewage in that area of metropolitan Toronto. These plants have been constructed with a minimum of expense, on the understanding that eventually they would be abandoned and the sewage conveyed to adequate plants near the shore of Lake Ontario. In all cases, they are located in the river valleys, which will enable them to be taken out of service when sanitary intercepter sewers are installed in those valleys. The reason for the construction of numerous small plants was the pressure of development over a wide area. Some of them were installed and paid for by land subdividers since they were less objectionable and less expensive than individual septic tanks, which would have been the alternative in an unsewered area.

Sewage Treatment in the Future

The main sewage treatment plant at Ashbridge's Bay, which provides only primary treatment at present, was constructed with the approval of the Ontario Department of Health, which body directed that the installation of secondary treatment facilities must be commenced within four years of the time the primary plant was completed. Consulting engineers have now been engaged by metropolitan Toronto to prepare plans for the immediate construction of this second stage, and extension of the sea wall protecting the site from Lake Ontario is presently underway at an estimated cost of $200,000.

The main plant will be enlarged eventually to serve a population of one million persons, with a dry-weather flow capacity of some 120 million gallons per day. This plant will serve the entire Don River watershed within the metropolitan Toronto limits, except for a small portion of the flow which will continue to be treated at the North Toronto sewage treatment plant.

To serve residents in the Humber River and Mimico Creek watersheds, construction of a sewage treatment plant near the mouth of the Humber River has been recommended.

This plant will finally receive sewage from the village of Swan-

Table III. Current Authorized Sewage Treatment Projects.

Plant	Estimated Cost	Work to Start
Main Plant	$26,000,000	1954
Humber Plant	14,000,000	1954
Highland Creek Plant	12,000,000	1954
Mimico Plant (Addition)	300,000	1954
Rockcliffe Plant (Temporary Addition)	175,000	1954
Weston Plant (Temporary Addition)	125,000	1954
Long Branch Plant	1,000,000	1955
North Toronto Plant (Vacuum Drying)	400,000	1955
Etobicoke Plant (Addition)	1,000,000	1955
TOTAL	$55,000,000	

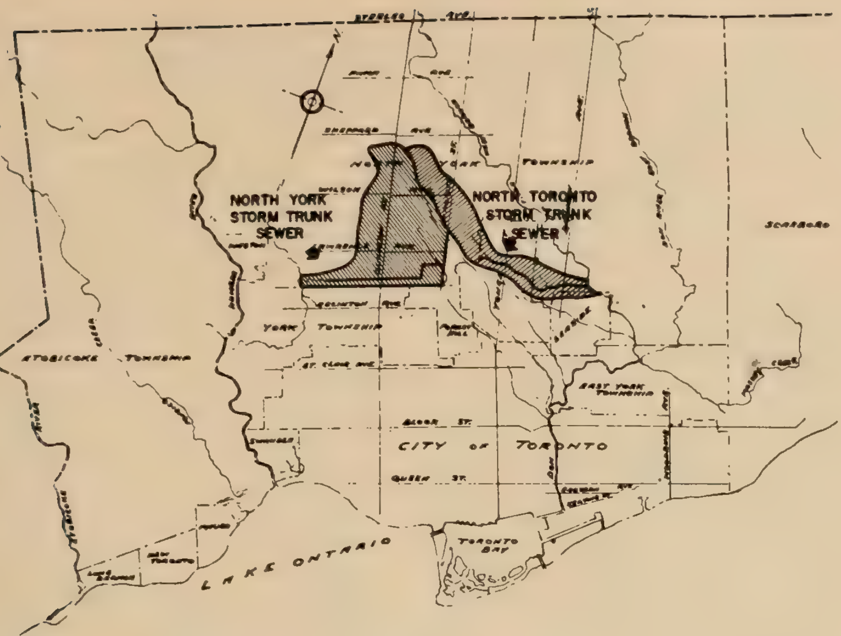


Fig. 4. Storm trunk sewer construction.

sea, the township of York, that part of the township of North York west of a height of land in the vicinity of Dufferin Street, the greater part of the township of Etobicoke, and a section of the westerly part of the city of Toronto, presently draining to the main plant at Ashbridge's Bay. Ultimately, it is expected that the plant will have a capacity of 87.5 million gallons per day, and serve a population of 800,000.

The North Toronto plant will be continued in operation, with its present overload relieved by construction of a sewer link to the interceptor leading to the main plant. Modern sludge handling equipment will be installed to relieve a serious situation developing at present with regard to disposal of sludge.

A third major plant will be constructed at the mouth of the Highland Creek, at the easterly end of the township of Scarborough. It will ultimately serve an area of some 23,000 acres, including the land assembly area at Malvern. Construction of this plant is now underway, with the initial unit designed to provide complete treatment for four million gallons of sewage per day. It is expected that its capacity will have to be doubled in a very short time, and that further enlargements will be made as development of its drainage area proceeds.

A further plant at the mouth of the Rouge River may be constructed at some date in the future, to serve Pickering township, to the east of Scarborough, and a small part of metropolitan Toronto.

The following plants will remain in service for a number of years, with possibly some expansion of facilities: Etobicoke, Glendale, Weston, Mimico, and Rockcliffe.

The Long Branch plant is severely overloaded, and consideration is being given to its improvement or its abandonment, and construction of an entirely new plant, probably in conjunction with the township of Toronto, which adjoins metropolitan Toronto on the west, to serve the lower Etobicoke Creek valley.

Table IV. Extensions to Trunk Sewers.

Sewer	Estimated Cost	Work to Start
Highland Creek Trunk	$ 7,000,000	1954
Black Creek Trunk	1,400,000	1954
Humber River Trunk	2,800,000	1954
Coxwell Trunk	2,800,000	1954
Humber Valley Trunk	500,000	1954
Etobicoke Trunk	1,250,000	1956
Massey Creek Trunk	740,000	1957
West Branch Don River Trunk	2,100,000	1956
Don River Trunk	510,000	1959
Wilket Creek Trunk	900,000	1956
High Park Trunk	450,000	1960
East Branch Don River Trunk	2,526,000	1956
TOTAL	$22,976,000	

Table III outlines current sewage treatment projects, as authorized and given priority by the Metropolitan Toronto Council.

Metropolitan Trunk Sewer System

On July 1, 1954, metropolitan Toronto, under by-law No. 144, assumed control of trunk sewers indicated on Fig. 2, asserting powers vested in it by the Municipality of Metropolitan Toronto Act. As may be seen from the plan, most sewers which drained sewage from a neighbouring municipality were assumed by the metropolitan corporation, in an attempt to eliminate one difficulty which past experience had indicated would stifle development. Other major interceptors were assumed on the basis of the area served by the sewer. Because of the combination of sanitary and combined systems in the area, as pointed out earlier in this paper, it was not possible simply to classify every sewer above a certain diameter as a trunk sewer. Careful consideration was given to this problem before the decision was reached as to which sewers would be classified as metropolitan trunks, and consultations were held with the municipal engineers of each of the area municipalities.

Plans for the extension of the trunk system are now well advanced, and in some instances, construction is under way. Figure 3 illustrates the proposed interceptor sewer extensions, which will, in the main, follow the river valleys.

Table IV lists the various projects and their value.

The Highland Creek trunk is at present nearing completion, having been designed by the township of Scarborough, engineering department, and checked by the metropolitan works department. It is expected to extend from the new plant at the mouth of Highland Creek to Brimley Road and Lawrence Avenue, early in 1956.

The Black Creek trunk, which extends from our Rockcliffe sewage treatment plant to our Baker Downs sewage treatment plant, along the valley of Black Creek, is now well advanced in the planning stage. Preliminary surveys are complete, soil boring work has been carried out, and will be further extended in the near future. Construction will be well advanced by the end of 1956.

The Humber River trunk sewer, extending from the river mouth to a point near Lambton golf course will be started early in 1956.

The Coxwell trunk extending from the main plant at Ashbridge's Bay northerly to the Don River in East York has been turned over for design to consulting engineers. Soil investigations are currently in progress for this 96-inch diameter sewer, which is proposed to be constructed in tunnel, at depths up to 160 feet below surface level. Experts in soil mechanics have been engaged to interpret the findings of the drilling contractor, in order to advise the proper structural design, and to predict the method of tunnelling most likely to be found necessary. Tenders are to be invited shortly.

The Humber Valley trunk, authorized for 1954 commencement, is now completed, and extends sanitary drainage facilities some 1½ miles northerly along the Humber River from a point south of Summerlea golf course. Temporarily, sewage from the area served by this sewer will be treated at our Weston sewage treatment plant.

The Etobicoke trunk is a northerly extension of the Humber River trunk, and will extend from Lambton golf course to a point north of the town of Weston.

The next four projects in the list, the Massey Creek, the West Don River, the Don River and the Wilket Creek trunks, as well as the East Don River trunk, form the Don River drainage system, radiating out from the northern terminus of the Coxwell trunk sewer. Their design and construction will follow commencement of the Coxwell trunk, which provides their outlet and a connection with the main sewage treatment plant. The East Don trunk, however, has been advanced to 1955. In a recent decision, the metropolitan council refused to permit further development of small sewage treatment plants proposed by subdividers, and proposed instead the immediate installation of the permanent trunk sewer. This interceptor will provide a drainage outlet for 15,000 acres in the township of North York.

The High Park trunk is designed to intercept flow from the northwest section of the city of Toronto, and may drain an area of approximately 2,500 acres. Its construction is set for the future, after preliminary development of the Humber plant.

Storm Drainage

As authorized by metropolitan council, storm projects are:

Project	Estimated Cost	Work to Start
Open Creek Channel...	$1,000,000	1954
North Toronto Trunk..	1,100,000	1954
North York Trunk.....	2,000,000	1954

As yet, the metropolitan corporation has not assumed any storm sewers as such, preferring to give the matter careful study before making a decision. Because of their purpose, storm sewers tend to be larger, and more costly, than sanitary trunks. Therefore, metropolitan Toronto will try to keep all sizeable watercourses open within the newly expanding areas, to avoid capital cost of construction of these large sewers at the present time. However, two major storm drainage projects are included in metropolitan Toronto's works program. Areas drained are outlined on Fig. 4. Both sewers are urgently required to permit development of a considerable area of the township of North York.

The North Toronto storm trunk will remove storm water from the North Toronto combined sewer system, and thus relieve the North Toronto sewage treatment plant. Several creeks are to be intercepted at the point where they enter the present North Toronto system and be diverted along a former creek bed by open channel and by piping where necessary. It is hoped to make it an attractive feature of the city of Toronto's parks system by the use of proper landscaping. Work is now under way on this project. The removal of creek water from the North Toronto trunk system will create capacity in those sewers for draining sanitary sewage from a large area of North York.

The North York storm trunk will intercept a number of creeks at present flowing from North York into York township, the village of Forest Hill, and the city of Toronto, and discharge the flow to Black Creek, a tributary of the Humber River. Major relief will be given to overloaded sewers in York township and Forest Hill by this project. Three contracts have already been awarded on this work.

Another function which was given to metropolitan Toronto under the act was the supervision of design, construction and maintenance of all works draining to metropolitan watercourses, trunk sewers, or sewage treatment plants. As a result, during the period since January 1, 1954, all thirteen area municipalities have submitted plans of proposed drainage works to the metropolitan administration for approval of design and financing. The chief advantage is the establishment of uniformity throughout the area in sewer design, as well as an overall control of expenditure which maintains metropolitan Toronto's splendid financial position. Construction standards have been left to the area municipalities to enforce, for a large inspection staff would be required to oversee all works in the area and in all cases the various municipalities have well trained and experienced personnel.

Associated with the foregoing, all new land subdivisions are reviewed for the metropolitan Toronto planning board and a report made about availability of sanitary drainage and treatment facilities. Recommendations and comment are also made on surface drainage requirements.

In the field of industrial waste, regular inspection of abattoirs, tanneries, refineries, soap works, etc., are made.

In conclusion, a brief summation of the points brought out by this paper might be in order. We have seen that the Toronto area is one of the fastest expanding districts in North America; that the rapid expansion is creating tremendous difficulties in many fields of public services, particularly water supply, drainage and sewage treatment, and transportation. Because the city of Toronto and its suburbs were experiencing difficulty in finding the way to provide the area with the services it needed, the municipality of metropolitan Toronto came into being.

Metropolitan Toronto at once engaged competent experts to set out a master plan for the provision of the services, with the financial resources of the entire area now available to back the debenture debt which must be assumed to pay for them.

(Continued on page 36)

Radar Echoes from the Aurora and the use of Doppler Techniques

A. G. McNamara,
National Research Council,
Radio and Engineering Division.

The author discusses the theories of radio reflection from the aurora, which has been studied extensively by radar and Doppler techniques only in very recent years. It is concluded that auroral radar observations can provide information not only about the aurora itself, but also about the physics of the upper atmosphere and radio propagation in the ionosphere.

The history of radio reflections from aurora is quite young. In Norway in 1940, Harang first observed unusual echoes at times of aurora using a frequency of 40 Mc/s. These "aurora echoes" occurred at frequencies at which normal ionospheric echoes could no longer be obtained, i.e. in the VHF range, from 30 Mc/s. to several hundred megacycles.

World war II saw the advent of high-power VHF radar, and after the war some of this equipment became available for research purposes. Since then, auroral radar studies have been pursued strongly in Canada, Norway, and the United States and in England. At Saskatoon, where visual studies have been carried on for many years, radar observations of aurora were begun by Currie, Forsyth and Vawter in 1948.

The Aurora

Canada is very well situated for auroral observations as may be seen by referring to the map (Fig. 1). The auroral zone is the region in which the visible auroral occurrence is most frequent. This zone is a roughly circular annulus of about 23° radius centred at the geomagnetic pole. The geomagnetic pole, which is defined by the main part of the earth's external magnetic field, is not coincident with the magnetic dip pole, but is actually situated near Thule in Greenland. The magnetic control of auroral occurrence arises because the high speed particles which enter the atmosphere to produce the aurora, are charged particles and hence are constrained to follow certain paths.

The high-speed primary particles strike the air molecules during their passage through the atmosphere and excite and ionize them. The visible light which is emitted is called the aurora. The lower edge of auroral arcs and bands are remarkably constant in height — some 94 per cent of all auroras lie between 90 and 130 km. above the earth, the most frequent height being 108 km. (100 km. = 62 miles.)

The ionized particles within the aurora are mainly positive ions of oxygen and nitrogen and (negative) electrons. The index of refraction of a medium is modified by the presence of free charged particles. This effect can be very pronounced at radio frequencies with the charge densities encountered in the ionosphere. The index of refraction (in the absence of an external magnetic field) is given by

$$n = \sqrt{1 - \frac{Ne^2}{\pi m f^2}} \quad \ldots\ldots\ldots (1)$$

where e = the electric charge of the ion.
m = the mass of the ion.
f = the frequency of the electromagnetic wave.
N = the number density of the ions.

From equation 1 it is apparent that the deviation from free-space propagation is inversely proportional to the mass of the ions present. Hence, since the positive ions are of the order of 30,000 times the mass of the electrons, the interaction with the electromagnetic wave will be due almost entirely to the free electrons.

Actually the reflection process is complicated by further considerations such as the size of the electron cloud relative to the wave length employed, the density of the cloud, the density gradient within the cloud, the geometrical shape of the cloud, and its orientation with respect to the transmitter and the receiver.

A critical reflection process, similar to that which occurs at normal ionospheric layers, has been supported by Currie and Forsyth to account for auroral echoes. If the electron density becomes sufficiently high to reduce the refractive index, n, to zero or to negative values, then the wave cannot penetrate the ionized region and total reflection occurs. This is called the critical electron density and its value may be found from equation 1. The condition is that

$$\frac{Ne^2}{\pi m f^2} \geqq 1 \ldots\ldots\ldots\ldots\ldots (2)$$

or, the limiting critical density is

$$N_c = \frac{\pi m f^2}{e^2} = 1.24 \times 10^{-8} f^2 \ldots (3)$$

If this reflection process is assumed to be valid, the reflection of 106 Mc/s. waves implies an electron density of 1.4 x 10^8 electrons/cm^3., at least within small volumes of the aurora. This value may be compared with the normal maximum electron density of the E-layer which is of the order of 10^5 electrons/cm^3.

The first VHF radar equipment operated at Saskatoon produced 50-kilowatt 35-microsecond pulses at 106 Mc/s. with a highly directional antenna. Later, a similar radar on 56 Mc/s. was added to permit dual frequency operation. More recently, a 196 Mc/s. set and a 91 Mc/s. Doppler radar have also been employed.

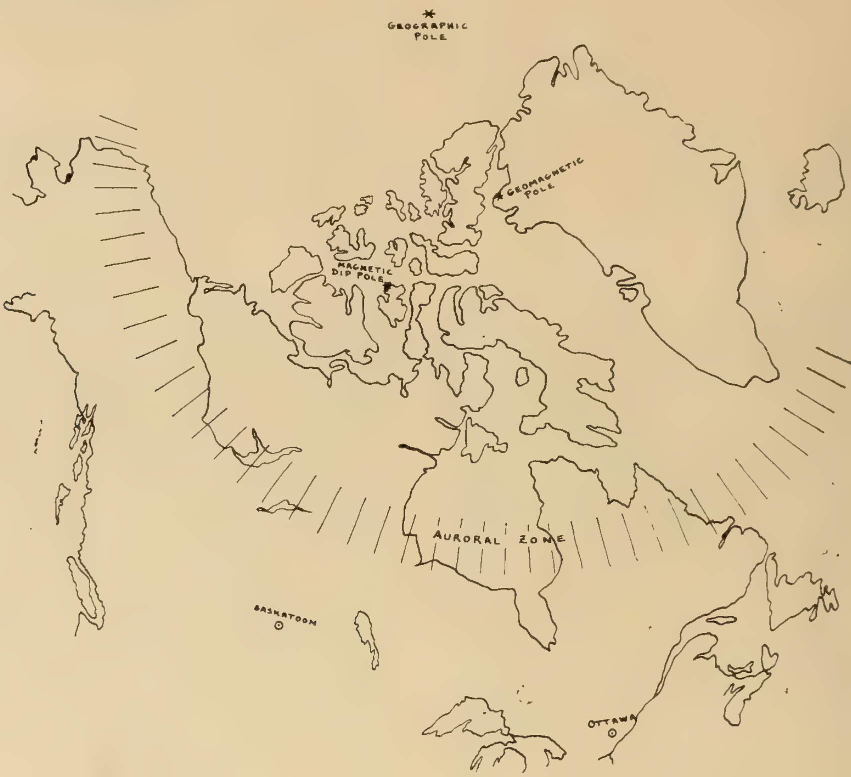


Fig. 1. Canada is well situated for auroral observations, as indicated by this map, which shows the auroral zone, in which visible auroral occurrence is most frequent. The relative positions of the geomagnetic, magnetic dip, and geographic poles are also shown.

In Ottawa several years ago, during the course of the National Research Council's meteor radar program, auroral echoes were observed several times with the 200-kw. meteor radar operating at 33 Mc/s.

Figure 2 shows the observed distribution of echoes obtained at Saskatoon, corrected to take account of the variation of auroral occurrence with position. The presence of the maxima and minima are due largely to the lobe structure of the radar beam. Superimposed is a curve representing the theoretical distribution (for a height of reflection of 105 km.) which would be expected. In azimuth, the maximum echo occurrence is centered at geomagnetic north.

A vitally important observational fact is indicated in Fig. 2. Echoes cannot be obtained, even from the most intense auroras, when they are at high angles of elevation from the radar station. With the VHF radars at Saskatoon, echoes have never been obtained from aurora at elevation angles greater than about 18 or 20 degrees. This strong "attenuation" effect is clearly shown in Fig. 2 by the deficiency of echoes in the second lobe.

Figure 3 gives a graphical description of the echo geometry, showing how echoes are obtained at ranges of 350 to 1150 km. Angle-of-arrival experiments at Saskatoon have shown that the reflecting regions lie in a thin layer of very constant height at about 105 km. This height agrees closely with the lower border of most visible auroral forms. The orientation of the main part of the earth's field (the dipole field) is also shown. It is along these lines of magnetic force that the incoming primary high speed charged particles travel.

At present there are three entirely different theories of the reflection process which attempt to explain the absence of echoes at high angles. These may be described as (1) the ground scatter theory, (2) the coherent scatter theory, and (3) the absorption theory. Harang, in Norway, has proposed that a forward reflection occurs to the ground via sporadic E-type clouds of ionization which are associated with auroral disturbances. The radiation strikes the ground and some of it is scattered back over the same path to the transmitter. In a manner analogous to oblique ionospheric reflection at lower frequencies, the ionized clouds will only reflect waves of a given frequency when the product of the critical frequency of the cloud and the secant of the angle of incidence on the lower surface of the horizontally stratified cloud is equal to or greater than the frequency of the wave employed. By the angle-of-arrival measurements at Saskatoon, we have shown that

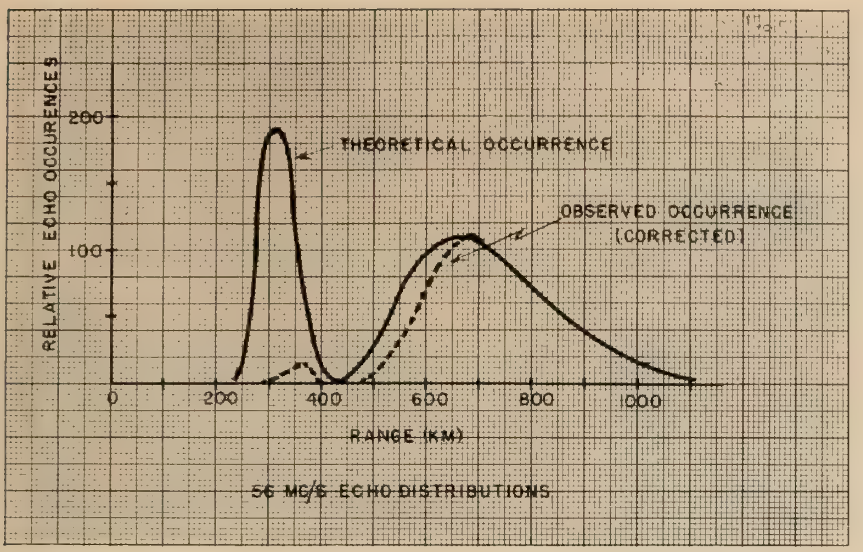


Fig. 2. Observed distribution of radar echoes obtained at Saskatoon.

the echoes observed at Saskatoon do not arise by such a process, but rather are the result of direct reflections from ionospheric regions.

The other two reflection processes involve direct reflection. The coherent scatter theory of Moore and Booker assumes that the auroral ionization is in the form of long trails oriented along the lines of the magnetic field. Furthermore it is assumed that the ionization density is less than the critical value. When the radiation is incident normally upon these trails, the reflected signal is enormously enhanced by virtue of coherent reradiation by all the electrons in the trail. This perpendicularity condition can only be satisfied in certain regions northward of the radar station.

The absorption theory, proposed by Forsyth and Currie, postulates that a strongly absorbing region must exist below each reflecting centre, and that the re-radiation pattern of the electron clouds is omnidirectional. At low angles of elevation, the radio waves can pass above the absorbing region and meet the reflecting cloud. At higher angles, the waves must pass through the absorbing region and are lost.

At present the observational evidence seems inadequate to exclude one or the other of the latter two theories.

Doppler Techniques

A new line of radio investigation of auroral reflections has been employed within the past few years. This is based upon the use of Doppler radar techniques. With this type of apparatus, a signal is transmitted whose frequency and phase are accurately controlled by a continuously-running precision crystal oscillator. The returning echo signal is mixed with this reference frequency in the receiver. If the two differ in frequency, their beat note emerges from the receiver as an audio frequency note which is the Doppler shift. If the frequency shift of the transmitted radiation is produced by a moving target, the Doppler beat is related to the radial velocity component of the target by

$$f_D = \frac{2v}{\lambda} \dots\dots\dots\dots\dots\dots (4)$$

where λ is the radio frequency wavelength.

In the apparatus employed, $\lambda = 3.31$ metres (90.7 Mc/s.) and hence

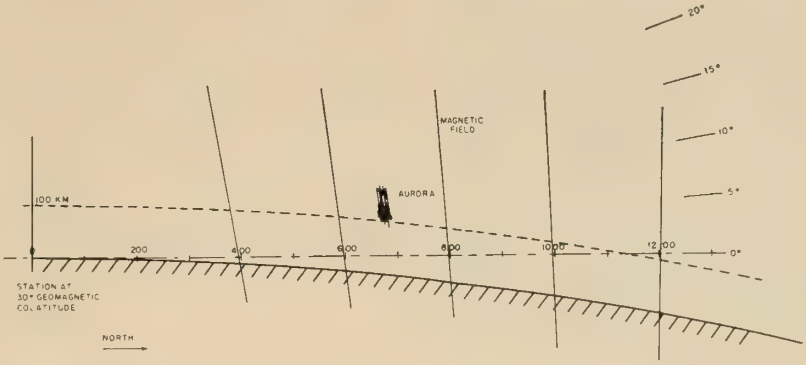
$$v = 1.65\ f_D \quad \text{metres sec.} \dots\dots (5)$$

This radar was actually a "double-Doppler" radar in which two coherent detectors are supplied with two reference signals phased at 90 degrees. The phase relation of the resulting two audio output signals indicates the direction of motion of the target, i.e., whether the Doppler shift is positive or negative.

To record and analyze the signals returned from the aurora, a spectrum analyzer was designed to display the spectrum of the echoes in a form suitable for rapid recording. A sideband separator circuit differentiates between the positive and negative Doppler components and directs them toward their respective bank of five tuned audio circuits. The centre frequencies of the five tuned amplifiers in each bank are staggered uniformly across the audio passband. The outputs of the tuned amplifiers are rectified and applied to individual milliammeters which are photographed simultaneously by a single-frame electrically-operated camera. The meter readings are used to plot graphs showing the spectra of the signals.

The spectra obtained exhibit two types of frequency shift. Firstly, the transmitted spectral line is broadened, more or less symmetrically, to widths of from fifty to perhaps several hundred cycles. The widths may be correlated with theoretical deductions about turbulence, target duration, or expansion and collapse of ionized surfaces under the action of diffusion and recombination. Secondly, *en masse* shifts of the spectrum are observed which can be correlated with the movements of the entire auroral formation.

Fig. 3. The geometry of auroral radar reflections.



Conclusion

In conclusion, it may be stated that auroral radar observations can provide not only information about the occurrence, structure, and origin of aurora, but also about the physics of the upper atmosphere and radio propagation in the ionosphere. √

DISCUSSION

. . . of Technical Papers

The Tide and the Crisis

By G. E. Hall, President, University of Western Ontario, London, Ont.

***The Engineering Journal*, December 1955 issue, page 1671**

K. F. Tupper, M.E.I.C.[1]

Dr. Hall has pointed out very clearly the situation which will arise in just a few years' time. He has also referred to the various ways in which the situation may be met, which are three in number.

The first way is by exclusion. We can keep the would-be university students out. This can be done by raising admission standards, by setting admission quotas, by raising tuition fees, or by some combination of these methods. I share Dr. Hall's emphatically stated opinion that excluding students is not an acceptable solution.

The second way is by dilution. We can revert again to the position which prevailed between 1945 and 1950 when universities had too many students and not enough teachers. This way is also not an acceptable one. When I was a student at the University of Toronto the ratio of students to professors in the faculty of applied science and engineering was about 23:1. For many years during that period the ratio was near this value. During the period of post-war veteran "bulge" the ratio of students to professors rose beyond 100:1. At that time we had the almost ridiculous situation that students were receiving lectures in classes of 1100 using Convocation Hall as a lecture room. I submit that that was a poor way to carry on university teaching. We were forced to do it with the veterans, but it will not do as a way of meeting the situation which lies ahead.

The third way is by expansion. We can augment and expand our institutions of higher education. I do hope that this will be the chosen course. I also hope that we will recognize the necessity of increasing the number of such institutions. I am convinced that there is a size beyond which a university should not grow. Some of our universities may already have reached this size. While quotas restricting the number of students in an institution may be bad for society they may be good from the point of view of the institution. If I am right, even in part, then we must give every encouragement to the establishment of new colleges and to the growth of the smaller ones which have been started in recent years.

I was interested in Dr. Hall's suggestion that there might be more direct support of universities by industry. I think it is essential that universities should receive their financial support from as many sources as possible. Only in this way will it be possible for them to maintain the freedom which is essential for their healthy existence. I express the hope that the support of universities will not fall by default wholly into the hands of government. There is a real danger of this, in which case higher education would become another branch of the civil service. Universities need income from fees, they need bequests, they need gifts from industry and from living individuals.

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[1] President, Ewbank & Partners (Canada) Limited, Toronto, Ontario.

Photoelasticity for Design Improvement

by

I. W. Smith, Associate Professor of Mechanical Engineering, University of Toronto.

***The Engineering Journal*, January 1956 issue, page 15.**

T. R. Loudon, M.E.I.C.[1]

May I congratulate Prof. Smith on his very clear and concise description of the photoelastic method. This method is an excellent addition to ordinary stress calculations. There are many cases of stress concentrations which can only be solved by photoelastic analysis.

I have used this method for the past thirty-two years and I have always wondered why it is not used more by manufacturers. My own conclusion is that those who insist upon giving the impression that the method entails some deep mathematical solutions are to blame for creating the wrong impression.

Any engineer who has a good university training can operate the method quite easily.

Dr. W. Shelson, M.E.I.C.[2]

The fundamental stress-optic laws were established just over a century ago by Neumann, Maxwell and Wertheim, but the application of this remarkably effective aid to structural analysis has not yet attained the widespread use that is its due. Thus, in presenting this illuminating and comprehensive review of photoelastic stress analysis, Professor Smith has made an important contribution towards the wider acceptance of this technique by underscoring both its usefulness and flexibility.

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[1] Engineering, The De Havilland Aircraft of Canada Limited, Toronto.

[2] Hydro-Electric Power Commission of Ontario, Toronto.

Any reader of this paper will undoubtedly realize from the many photoelastic methods and techniques described that this field is not one that can be easily mastered. What may not be as evident is that a knowledge of photoelasticity alone is an entirely inadequate basis for the solution of the structural problems confronting the designer. The competent photoelastician must have, in addition to photoelastic "know-how", a thorough grounding in the mathematical theory of elasticity, strength of materials including theories of failure, physical and geometrical optics, and a modicum of chemistry relative to plastics. Above all, photoelastician must be aware of conventional mechanical and structural design, and keenly cognizant of the complexity of the designer's task. Perhaps, the relatively slow application in industry of photoelastic analysis has, to a considerable extent, been the result of a lack of engineers with the necessary training for this demanding work.

I would like to make some specific comments on matters dealt with in this paper. Professor Smith notes that initial stresses may exist in the model before any load is applied, and that these initial stresses may be determined and the final fringe pattern adjusted accordingly. It will be realized that simple algebraic subtraction of fringe orders may lead to inaccuracies unless the directions of the stresses prior to and after loading are identical. It is likely too that part of the initial fringe pattern is not due to stresses, but is the result of inhomogeneities in the material. This may account for the incomplete effectiveness of annealing procedures in removing the initial fringe pattern.

The paper refers also to the use of photoelastic stress analysis in vibratory and impact studies. In view of the present limited knowledge of the precise significance of the fringe pattern under dynamic conditions, the use of photoelastic analysis in such cases would appear to be inadvisable except for research purposes.

Most engineers are probably unaware of the use of photoelasticity in three-dimensional problems, and this paper clearly reveals the essential features of this fascinating development. The difficulties in obtaining similitude when Poisson's ratio is one-half are well brought out. The comment by Hickson in reference (61), mentioned by the author, that "the errors caused by differences in Poisson's ratio are not as significant in the maximum principal stress as in the lesser ones" does not much simplify the problem of determining accurately the maximum principal stress since this stress is not obtainable independently of the lesser stresses. Thus, the general use of three-dimensional photoelasticity must remain for some time on a qualitative or comparative basis in design and as an elegant check on theoretical analysis.

R. M. Sachs[3]

Professor Smith's paper is a lucid summary of the field of photoelastic stress analysis and should be a great help in familiarizing designers with the benefits which can be realized from the use of this method.

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DISCUSSION

The editor

invites discussion of papers

appearing in the *Journal*.

Readers may

contribute to this section by

sending appropriate comments to the *Journal* office.

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In the field of design with which I am most familiar, that of aircraft gas turbines, competition for low weight is vigorous. There are constant pressures to reduce factors of safety on all mechanical parts. For the designer to be able to accede to these pressures, a more precise knowledge of stress levels encountered during operation is necessary. We feel that photoelastic method of stress analysis is one very valuable tool which is contributing to that knowledge. For many items, such as fabricated structures, frames, and shells, structure tests to failure with the use of strain gauges and stress coat are thought to give more relevant design information than photoelastic stress analysis could. The reason is that the loads involved in these members are usually very large and infrequently applied, and the criteria of failure are excessive yield or complete collapse. In these structures, local regions of high stress are usually permissible due to the ductility of the material used, allowing a redistribution of stress in a more even manner, until finally excessive yield or collapse occurs.

Generally speaking we feel that photoelastic stress analysis is unlikely to give much relevant information to a designer of a composite structure which is intended to be stressed in the plastic range under the design limit load.

Some of the most critical parts in a gas turbine engine are the blades, discs, and shafting. These parts are frequently subjected to fluctuating loads for long periods of time. It is here that we derive the greatest help from the photoelastic methods of stress analysis. The stress concentration factors illustrated by fringe patterns in pictures of photoelastic tests are very significant for parts loaded in this manner. An example of a detail which is extremely important and requires careful attention to prevent fatigue failures is the root fixing which provides a mechanical connection between the turbines or compressor blade and the disc. This connection must withstand very high steady tensile loads due to centrifugal forces and at the same time must resist fluctuating loads due to the uneven gas forces loading the blade itself. In most cases where we have witnessed a root fixing failure, it has been due to fatigue caused by the fluctuating loads rather than a direct failure due to the steady loads. For help in this particular problem we have referred to the results of work carried out by R. B. Heywood (Ref. — "Tensile Fillet Stresses in Loaded Projections" by R. B. Heywood, Institute of Mechanical Engineers, Applied Mechanics Proceeding 1948, Volume 159, page 384). It is interesting to note that Dr. Heywood's analysis and the empirical formulae resulting, depend mainly upon photoelastic stress analysis.

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[3] Design Analysis, Orenda Engines Ltd., Toronto.

Professor Smith's bibliography attests to the volume of published data, based upon this method of analysis, which is available to assist the designer. Despite the wealth of information available, many machine elements being designed employ profiles, combinations of holes, fillets, steps etc. which cannot be analysed adequately using existing data. It is therefore certain that an increasing number of engineering organizations will be setting up photoelastic stress analysis facilities of their own.

The Author

Since he was among the first to use photoelasticity for stress determination, having a pair of Nicol prisms long before Polaroid was available, it was a great privilege to have Professor Loudon present at the meeting and to hear his comments. The author shares the view that by dispelling some of the mystery, photoelasticity should gain wider use. There are of course many difficulties, some of which at the present state of the art seem nearly insuperable. Dr. Shelson has introduced a note of caution by mentioning two of the problems. While the presence of initial stresses (or other optical disturbances) in a model is usually shrugged off by writers, the photoelastician is loath to place full dependence on the results of using such a model. Since the time of writing the original paper, the manufacture and sale of Fosterite has been discontinued and it has become necessary for those doing stress freezing to cast their own materials. Probably the most favoured of these is the epoxy resin, such as Bakelite ERL 2774 or Araldite 6020, solidified with phthalic anhydride, and given a heat treating cycle that is supposed to leave an optically clear (though amber coloured) casting. Blame for residual stress and other casting defects can no longer be directed toward the material supplier, but it is perhaps preferable to have these under direct control.

Dr. Shelson also points out that dynamic stress work must be handled with care. For example room temperature creep, which is an irritation when working with static stresses, becomes an affliction when dealing with rapidly fluctuating stress. It is also very difficult to induce the required vibratory stress in a model (for example the second mode torsional in a cantilever) without departing from similarity to the prototype, and it is still more difficult to "see" photoelastically the stresses that are developed. But this is a reason for enticing more people into the fold of photoelasticity, for its progress must inevitably be slow if there are only a few with the patience to pursue and overtake the problems.

As a stress analyst confronted with many widely varied problems, Mr. Sachs' comments are valuable. It is true that photoelasticity is only one form of experimental stress analysis and that it cannot be expected to solve everything. The low modulus of elasticity of the model materials results in large deformations, particularly in a "stringy" type of structure, and these may invalidate the method. On the other hand new cementing and casting techniques make possible a model complexity not hitherto achieved and it is to be hoped that greater versatility will bring photoelasticity out of the research laboratory into the design laboratory. Even when similarity between the model and the prototype cannot be obtained completely, some information, if interpreted correctly by the analyst, is preferable to a complete lack of applicable information.

A Complete Sanitation Program for Metropolitan Toronto

L. B. Allan

(continued from page 30)

We have examined at some length the many difficulties, and the plans which are now envisaged in order to overcome them, in relation to sanitary and storm drainage and sewage treatment over the entire metropolitan Toronto area.

That a tremendous job faces us, no one can deny. Our program involves a capital expenditure of some eighty million dollars in the next twenty years. Within five years, we hope to have trunk sewers and sewage treatment available at any point inside our boundaries. After the basic service is available, it can then be expanded and improved, so that metropolitan Toronto will rank with the finest communities in the world in the field of drainage and sewage treatment, as it already does in so many other respects. √

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Erratum. — The author of the paper "The Possibility of Complete Solar Heating of Canadian Buildings" (Nov. 1955 issue, p. 1501) was inadvertently quoted without reference to his membership in the Engineering Institute of Canada. Apologies to Prof. F. C. Hooper, M.E.I.C.

The Engineering Institute of Canada

ANNUAL MEETING

May 23-24-25, 1956

Sheraton-Mount Royal Hotel, Montreal, Que.

ABSTRACTS . . .

OF RECENTLY PUBLISHED ENGINEERING LITERATURE

BIG LOOPS IN SUBMARINE CABLE LINES SOLVE PROBLEM CAUSED BY DEEP MUD

Engineering News-Record, June 2, 1955, p. 48.

A mile-wide bay with a bottom of soft, deep mud presented an unusual problem to builders of a communications link between the big Naval Air Station at Corpus Christi, Texas, and a new radio transmitting center across Oso Bay, in which soft silt had an average depth of 110 ft. with pockets believed to be as deep as 300 to 400 ft.

The local electric company had learned that poles would not stand up for any length of time in this mud. Hence the builders of the new communications link decided to use submarine cables. However, submarine cables of sufficient strength to meet the conditions found at this crossing would weigh 10 lb. per foot of length, which meant that they would sink slowly in the soft mud.

How deep the cables would sink or how long it would take them to reach a state of equilibrium could not be determined accurately. To meet this situation, it was decided that the cables should be laid across the bay bottom in looped lines of sufficient length to provide for settlement of the cables to the bottom of the soft mud. Using the best available information as to the depth of the mud, a tentative final profile was computed and then the length of the loops required to lay that length across the bay was increased about 60 percent to reduce strain on the cable should settlement be rapid at any one point along the cable line.

Finally, 60 ft. was added to the length of the cable to permit a reserve length of 30 ft. to be coiled in a big anchor manhole at each end of the submarine line.

Use of this reserve is not anticipated, but that arrangement has the advantage of simplifying the task of adding to the length of the submarine cable should periodic inspection of the manholes indicate that the computed amount of settlement was in error.

RUBBER CONVEYOR BELTS

R. W. Parris, *Rubber Developments,* v. 7, n. 4, Winter 1954, pp. 98/104.

Hundreds of miles of rubber conveyor belting are in operation giving efficient service and conveying annually millions of tons of materials and products at a very low cost. Rubber conveyor belts are made in a wide variety of types for conveying almost every kind of conveyable material.

In the majority of applications, the working life of the belt is governed by its degree of resistance to abrasion.

A rubber conveyor belt consists of a fabric interior, to provide the necessary strength, and a covering of rubber which serves the dual purpose of resisting abrasion and protecting the fabric from moisture. In some belts the fabric is treated to make it resistant to mildew, while recently chemically-treated cellulosic yarn of greatly enhanced strength has been used for the construction of belts. Where the maximum possible strength is required, the belt is reinforced with steel cord.

Some Special Types

For conveyance of products and materials up or down steep inclines, special types of belt are available. For packages, the belt has a gripping surface formed of numerous small isolated blocks or fingers. For lumpy or granular materials, cleats are provided on a smooth-faced belt. The cleats may be of metal or of rubber.

A rubber-coated steel band conveyor belt has been developed in Sweden. A belt which can shed water from the material being handled or can retain the water, according to requirements, is formed with moulded rubber ridges, ⅛ in. high in its surface. The incline of the belt and the angle of the belt idlers are adjusted according to whether the water is to be shed or retained.

A belt conveyor of novel construction, termed the cable belt conveyor, has recently been introduced. The belt itself is not subjected to driving pull, this being taken by two steel ropes, one at each side of the belt. The ropes are supported by pulleys mounted on ball-bearings and set at approximately 18 ft. centres. Spring steel straps are moulded in the belt at approximately 2½ ft. centres and project at each side of the belt for a few inches. At each of the projecting edges of the belt a shoe with rubber inserts is fitted so that it slides on the strap for a limited distance.

An entirely different type of belt conveyor, known as the *Zipper* closed-belt conveyor-elevator, is in effect a moving pipe line. It consists of: (a) a flat endless base-belt similar to the conventional rubber and fabric conveyor belt; (b) Flexible rubber side-walls hinged to the shoulders of the base-plate; and (c) interlocking rubber teeth moulded on the outer edges of the side walls. Immediately after material has been fed on the belt, the side walls are automatically closed around the material and the teeth interlocked. Rubber fins at the base of the teeth seal the belt and keep material from sifting out. The belt is automatically opened for unloading.

Idlers

Conveyor belts are supported on idlers, each idler consisting of one or more idler rollers mounted in a supporting bracket which is fixed to a base plate. For troughed belts the idler unit has three or five rollers so mounted that the belt forms a trough shape. Idler rollers are designed to retain lubricant and to rotate easily, thereby minimizing both belt tension and wear on the driving surface of the belt.

When abrasive or corrosive materials are being handled it is advantageous to provide rubber-covered idler rollers. Impact idlers are used at loading and transfer points to minimize wear on the belt. Where impact is very severe, as when logs or large heavy lumps of material are dropped on the belt, pneumatic tyres may be used to form the idlers.

A recent development is the hammock idler. The hammock idler consists essentially of a rubber tube which is flexed according to the load on the belt and allows the belt to assume its own shape of trough. As the extent of troughing necessary will depend upon the load being carried, the idler incorporates means for adjustment to meet these requirements. The use of the hammock idler reduces spillage as any tendency for the load to be nearer one edge of the belt is quickly corrected. The rubber tube is resistant to both abrasion and to continued flexing. Any impact which occurs when the loaded belt traverses the idler is readily absorbed by the rubber, but this type of idler is not intended for heavy impact duty at loading points.

The life of rubber conveyor belting will be prolonged by correct installation, frequent inspection and immediate correction of faults or repair of damage. The loading point of a conveyor receives most abrasion and nearly all the impact, and the life of the conveyor is therefore largely governed by the wear it receives at this point. To minimize this wear the material being handled should pass from the chute to the belt at the same speed and direction of travel as the belt and with a minimum amount of impact. Belt repair outfits are available and also portable vulcanisers for effecting belt repairs and for making vulcanised belt joints.

LATEST IN BUTT-WELDING . . .
LONG RAILS BY FLASH PROCESS

Railway Age, v. 138, n. 23, June 6, 1955, pp. 26/29.

At Albuquerque, N.M., a new chapter is being written in the history of continuous rail. There the Santa Fe is taking short ones (39 ft.) and fashioning them into long ones (about 1,440 ft.) by the Matisa-Schlatter flash butt-welding technique. The set-up at Albuquerque, represents the first use of this process in the United States.

Mobility Was Problem

Welding of continuous rail in Europe is done at so-called *depot* or permanent set-ups. This practice is not generally considered practical here because of the greater distances the long rails would have to be transported. Development of the Matisa-Schlatter process is the outcome of many months of intensive effort to adapt the Swiss version of the electric-flash method for use in this country, and especially to develop equipment of the required mobility.

As now perfected the equipment is permanently housed in three specially designed steel box cars. These cars contain:

(1) The plant used for generating the necessary electrical power for the welding process, and such additional power as is required to operate the various motors and lighting facilities required during operation.

(2) The welding unit, an air compressor and a water-cooling unit for cooling the welding electrodes.

(3) The grinding machines and a winch for moving the welded rail.

Arrangement at Albuquerque

The welding equipment is arranged on two tracks at Albuquerque. The welding and grinding cars are on one track and the power car is spotted on a second track directly opposite the welding car. The production line begins at a rail-feeding ramp at the rear end of the welding car and extends through the welding and grinding cars to a portable building which houses equipment for testing the welds.

Portable platforms at car-floor height, with access stairs to the ground level, are provided between the cars, between the grinder car and the inspection building, and completely around the rail-feeding ramp. These platforms provide easy access to any point on the welding line.

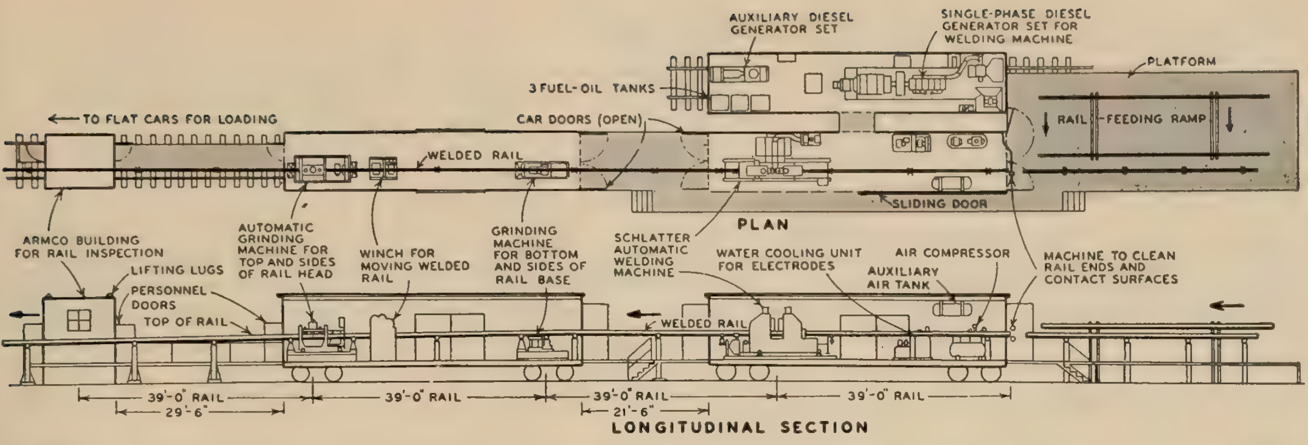
The preparation, welding, finishing and testing of the joints is carried out at six stations located along the length of the welding line. These stations are equally spaced so that each operation may be carried on simultaneously with all the others, thus insuring assembly line production.

The usual practice on the Santa Fe is to weld the rails into lengths about 1,440 ft. (37 rails) long. As the lengths come from the production line they are loaded directly on a string of 31 flat cars. On each car the rails are supported on a single specially designed assembly of 12 roller-bearing rollers mounted on a common shaft, thus accommodating 12 strings of welded rail. The draft gears of each car are blocked to prevent slack action in the train. Two trains have been provided so that one may be loaded while the other is transporting the rail to the unloading site.

Production and Personnel

The welding line is operated in two shifts with the expectation that full production, when reached, will approximate 180 welds per day. Eleven men are required for each shift, including the foreman and all personnel necessary to handle the rail.

Only full-length No. 1 and No. 2 rails are being welded on the Santa Fe. All rail sent to the welding line is blanked at both ends except that a limited number are drilled at one end only for use as end rails of the strings.


AUXILIARY DIESEL GENERATOR SET
SINGLE-PHASE DIESEL GENERATOR SET FOR WELDING MACHINE
PLATFORM
3 FUEL-OIL TANKS
← TO FLAT CARS FOR LOADING
CAR DOORS (OPEN)
RAIL-FEEDING RAMP
WELDED RAIL
SLIDING DOOR
PLAN
ARMCO BUILDING FOR RAIL INSPECTION
AUTOMATIC GRINDING MACHINE FOR TOP AND SIDES OF RAIL HEAD
WINCH FOR MOVING WELDED RAIL
GRINDING MACHINE FOR BOTTOM AND SIDES OF RAIL BASE
SCHLATTER AUTOMATIC WELDING MACHINE
WATER COOLING UNIT FOR ELECTRODES
AIR COMPRESSOR
MACHINE TO CLEAN RAIL ENDS AND CONTACT SURFACES
LIFTING LUGS
PERSONNEL DOORS
TOP OF RAIL
AUXILIARY AIR TANK
WELDED RAIL
39'-0" RAIL
29'-6"
39'-0" RAIL
39'-0" RAIL
21'-6"
39'-0" RAIL
LONGITUDINAL SECTION

LAYOUT of production line at Albuquerque. As indicated by heavy arrows rail flows through the various fabricating and testing operations to its final discharge in 1,440-ft lengths for loading on strings of flat cars.

COMMUNICATION . . . WHERE DO WE GO FROM HERE?

Vannevar Bush, *Electrical Engineering*, v. 74, n. 5, May, 1955, pp. 367/369.

Today there are diverse and complex means for communication. You are not interested in having me recite a catalogue of them. Nor have I any intention of lifting your spirits with a rhapsody on the wonders of modern communication. In fact, I think some of those wonders are still rather crude.

The simplest form of communication is between individuals, and the principal instruments — in addition to direct speech — are the telephone, the transmitted message, and the letter. We take just pride in our telephone system. Some people can now make calls all over the country merely by turning a dial; and more will soon be able to do so, without human intervention, and without human error except their own.

The sounds heard over the telephone bear a surprisingly close resemblance to those of the human voice, close enough in fact to satisfy any reasonable demands. What else is there to do? Well, the telephone is still, on occasion, a nuisance, breaking in on our hours of rest, work, or contemplation in a most peremptory manner. There may be ways, aside from having competent secretaries, by which conversations could be carried on when both participants, rather than just one, want to talk. Certainly there are more effective ways than those employed today of carrying on a conference of several persons. The only difference between a conference around a table, and one over a telephone is the absence of gestures and facial expressions.

Correspondence

Billions of letters are being written. This process is still extremely crude. To write the letter an individual talks to a stenographer or a machine, and what has been said is reproduced, often none too precisely, by a girl who pushes keys on a typewriter. This process can be shortened by talking to a machine and mailing a disk or tape, to talk back on a distant machine, but this does not readily produce a convenient record.

When a letter is mailed, a half dozen persons have to read the address and toss it into its appropriate compartment. This is utterly archaic. It is quite possible to read addresses photoelectrically, if they are in proper code, and to render all sorting automatic. The great bulk of the mail could be thus handled.

The second principal form of communication is from one to many, or from a small group to a large audience. It is usually unidirectional. The greatest instrumentation here is the printed word. Much progress is being made in printing. Better methods of printing can confidently be expected as well as better methods of distributing what is printed.

Entertainment is a form of communication. It is fortunate that entertainment and advertising have made possible the enormous growth of radio and television. Together with the press and magazines, these media are producing an informed electorate and a united public opinion throughout the country beyond anything that was possible without them.

The progress of civilization in peace time depends not only on current thoughts and findings, but on the skill and facility with which we create, store, interchange, consult, and utilize the whole record of collective past experiences. Enormous strides are being made in the development of methods for creating a record of what is learned—in printed words, by photography, or on a magnetic tape. Also, strides are being made in developing means for the transmission of ideas from one to another or from a central point to great audiences. But in one exceedingly important phase of the whole problem, little progress indeed is being made. This is the phase of finding in the record the information needed.

Libraries

Libraries are filled to overflowing and their growth is exponential. Yet in this vast and ever-increasing store of information particular items are still sought by horse and buggy methods. We are being smothered in our own product. While the work of thousands of men, full of significance and timeliness to others, is recorded with great care, a large and increasing fraction of this work is, for all essential purposes, lost simply because it is not known how to find a pertinent item of information.

The problem is not essentially one of techniques. It is rather one of deciding who is to do the job of clearing up the confusion and under what auspices. There are many good techniques available. Recently I participated in a study of how mechanization could be applied to the problem of searching in the Patent Office, where millions of items need to be scanned for equivalents of the combination presented in patent applications. There are several ways in which items can be scanned at the rate of 1,000 a second, selected in accordance with a complex code, and reproduced automatically.

But to code the scientific literature or legal documents or any other part of the mounting records and thus to place them under the control of machinery responsive to our will is a stupendous undertaking. Worse than that, it is everyone's business and the assigned responsibility of no one group in particular. The whole art of data handling is improving every day, and it would be a mistake to freeze upon a single system prematurely. So it probably would not be wise to plunge in at once and undertake a comprehensive and extensive program for, to use an example, the entire bulk of scientific literature. The time has most certainly arrived when special sections of the record can be subjected to mechanization with genuine benefit to those who use them.

Communication is the lifeblood of democracy. An informed and intelligent electorate is our bulwark against political chaos. Education of the people is dependent on the means of communication that are available. In its simplest form, a teacher talking to a group of pupils, communication is an essential element. But in the more complicated processes by which the citizens of democracy become informed, the problem of communication is more involved and extensive. Today there are intricate and powerful means for the interchange of thought among the entire population. On the skill and wisdom with which these means are employed depend the stability and prosperity of our republic.

IMPORTANCE OF KNOW-HOW IN CHEMICAL DEVELOPMENT

Industrial & Engineering Chemistry. v. 47, n. 5, May, 1955, pp. 982/984..

The cost of industrial research has been increasing at a staggering rate. For many years the chemical industry classification provided the largest segment of industrial research. However, in the last few years, the chemical industries now provide little more than 10% of the total or approximately $300,000,000 per year. Research expenditure has been made possible by a rapid increase in the number of scientists and engineers employed.

Almost as significant as the increase in research workers is the greatly increased cost per professional scientist or engineer; the annual average cost of a professional in industry has increased from $6,300 in 1927 to $21,500 in 1952.

The unit cost of a research worker, however, does not completely explain the increases noted. A number of forces have combined to increase the complexity of research projects over the past years.

It is obviously impossible to compare identical projects, but some typical examples give some indication of the changes at Shell's Emeryville Research Center. As shown in Table I, in the period 1933-38 pilot plant developments averaged 14 man-years, but in the period 1944-48 this had increased to 50 man-years per project. And when one examines figures that include not only the pilot plant development but also the research prior to it and the engineering effort that followed, the total manpower utilized per project increased from 55 man-years in the period 1928-38 to 160 man-years in the period 1946-53.

Table I
Chemical Project
Manpower Requirements

Period	No. Projects	Man-Years Project
Pilot Plant Investigations		
1933-38	16	14
1944-48	11	50
Commercial Projects		
1928-38	24	55
1939-45	13	125
1946-53	26	160

One of the reasons for increased research expenditure is the increased demand for chemical products. Since the cost of chemical research has averaged approximately 3% of sales for a number of years, this increased production would alone account for much of the increase in research expenditure.

No one in this field need be told that during the period of expansion, competition has increased materially. The few companies engaged in petrochemical manufacturing in 1931 have been joined by many others, until at the present time there are approximately 140 individual companies operating 300 plants. This rivalry has made it necessary for management to establish with certainty that capital expenditures will be made only for processes that are economically superior. This has led to a great increase in the use of process engineering evaluations, necessitating more detailed development and engineering efforts.

The rapidly increasing cost of construction also must be considered and every effort made to design plants requiring a minimum of capital investment consistent with reasonable manufacturing costs. Perhaps the most reliable index of construction costs is that provided by the *Engineering News Record.* This figure shows that the cost of construction has more than doubled since the beginning of 1946.

With this background, showing the influence of rapidly increasing markets, greater competition, and inflationary forces on research and development expenditures, there is a real incentive for research and development management to minimize expense by utilization of any available knowledge bearing on a specific problem. Among the sources of data available are the chemical literature. If chemical industry would exchange more information through increased publication, duplication of research and development effort could be materially reduced. When one considers the total expenditure in this field of $300,000,000 annually, even a small fraction shared would represent a real saving to everyone. Disclosures in the patent literature also provide knowledge which can be used effectively.

The most important source of information on which to base process development is the utilization of one's own research and development know-how on related processes. This source is obviously available in proportion to the extent of prior experience in the field involved, whether it applies to exploratory or bench scale research, pilot plant investigation, process design, or commercial operating experience.

Month To Month

Notes of the Institute and Other Societies, Comments and Correspondence, Elections and Transfers

Overseas Look for Canadians

Promotion of increased Canadian participation in foreign development works has been sponsored by the Canadian Manufacturers' Association, the Engineering Institute of Canada and the Canadian Construction Association.

Reason for the joint action of these three national organizations was the feeling that the opportunities which these projects present for Canadian manufacturers of capital goods can be improved in two ways: first, by improving and speeding up the channels of information in order that Canadian suppliers may be fully aware of potential requirements at the earliest possible stage; and, secondly, by promoting increased interest and activity in such projects on the part of Canadian engineering consultants, contractors, management specialists and technicians.

The joint liaison committee is headed by Hugh Crombie, M.E.I.C., vice-president and treasurer, Dominion Engineering Works, Montreal, who will represent the C.M.A.; B. A. Culpeper, M.E.I.C., manager and chief engineer, C. D. Howe Company, Montreal, who will act for the Engineering Institute; and C. G. Kingsmill, M.E.I.C., assistant to the president and director of Angus Robertson Limited, Montreal, who will represent the Canadian Construction Association.

Through this committee arrangements are being made for the collection and exchange of information regarding foreign undertakings in which Canadian engineers, contractors and manufacturers would be interested. The services of the Department of Trade and Commerce at Ottawa will also be utilized in this undertaking.

C.M.A. members who have overseas affiliations have been asked to report, on a continuing basis, on foreign developments and, with the co-operation of the other two sponsors, manufacturers will be kept abreast of important overseas contracts entered into by Canadian engineers and contractors.

This move should also be, in the long run, of value to Canadian manufacturers interested in consumer goods export. Experience has shown that Canadian exports of capital goods and technical services have a tendency to stimulate the foreign market for all sorts of other Canadian products which may be used in association with the products concerned.

Engineers' Joint Committee Formed

The civil engineers of Toronto have a concerted program of technical meetings this year, through the efforts of a committee representing Toronto members of the Institution of Civil Engineers (Britain), the American Society of Civil Engineers and the Engineering Institute of Canada.

On October 18, 1955, the first in a series of joint meetings of direct civil engineering interest was held. The inaugural paper was presented by Charles Hershfield, M.E.I.C., before a large audience in the McLennan Building of the University of Toronto. His subject was "One Cycle Moment Distribution for Structural Analysis".

The next meeting is scheduled for February 9, 1956, when a paper on "Waterworks and Fluid Mechanics" will be presented by Dr. Grant Huber in Room 103 of the School of Nursing of the University of Toronto. Professor Huber will discuss what effects fluid mechanics has, or should have, on our practical treatment of waterworks design. Specific reference will be made to the waterworks problems of Metropolitan Toronto.

The schedule includes also a tentative meeting on March 8, with a paper prepared by the Ontario Hydro structural research department; and one on April 12, at which the results of the N.R.C.

Cover Picture

The cover picture illustrates the installation of a 4-ft. diameter parabolic antenna reflector as part of an airborne profile recording system. Capable of measuring ground elevation on profiles to plus or minus 10 feet, it may also be used to measure terrain clearances from 1000 to 25,000 feet as a radar altimeter. The unit compensates for minor deviations of the aircraft from chosen barometric flying height so that the record obtained indicates the terrain contour along the flight line. Simultaneous ground position photography is featured.

Photo courtesy PSC Applied Research Limited.

Cobourg Beam tests will be presented by the Department of Building Research, N.R.C.

The joint civil engineering section came into being during the fall of 1955, the plan having been proposed in March to the sister societies by Harold Fealdman, M.E.I.C., on behalf of the executive of the Institute's Toronto Branch. The Institution of Civil Engineers had given its approval and offered financial assistance in May. Co-operation with ASCE was worked out later and in December agreement and financial support was announced by the Society.

Mr. Fealdman was appointed chairman of the committee. The secretary is B. Hardcastle, M.E.I.C. (c/o McColl-Frontenac Oil Company Limited, 8 Spadina Road, Toronto, Ont.) Their work in the interest of co-operative technical activity has been rewarding, and they volunteer to provide further information to anyone interested.

Ten Years of Aircraft Design and Production

When the second world war was over, Canada found itself with a great many new industries on its hands. In many instances the industries were not previously natural to this country but had been developed because of the exigencies of war conditions. One of these appeared to be the aircraft industry.

At the war's end most Canadians would have said there was no future in Canada for the aircraft industry and yet we now find it one of our most important industrial efforts. This has been a wonderful thing for Canada, not only from the point of view of employment for Canadians, but from the point of view of national defence.

Conspicuous in the group of companies that have been operating in Canada since the war's end is A. V. Roe (Canada) Limited. On December 1, 1955, they celebrated their tenth anniversary. This company has been unique not only in the field of aircraft manufacture but in the aero engine as well.

Back in 1945 Sir Roy Dobson and his associates representing the Hawker Siddeley group purchased the Crown owned Victory Aircraft plant at Malton, where Lancasters had been made during the war. The company's operations were very small in the beginning and certainly did not need a plant of this size. However, it was fortunate that the arrangements were made on such a generous scale because before long every inch of floor space was in demand.

In the beginning the company had 300 employees—today it has 22,000. It now consists of four separate companies with nine manufacturing and engineering establishments covering a total floor space of five and a half million square feet.

The companies controlled by Avro are Avro Aircraft Limited, Canadian Car and Foundry Company Limited, Canadian Steel Improvement Limited, and Orenda Engines Limited.

The list of products which are now manufactured includes four types of aircraft, two gas turbine aero engines, aircraft repair, overhaul and modification, aircraft ground handling equipment, mobile training systems for the R.C.A.F., guided missiles research, precision forgings and castings for aircraft, aero engines, consumer products, textile and wire and cable industries, light alloy products, heavy steel castings, railway equipment of all kinds for Canada and export to 26 foreign countries, railway track layouts, steel fabrication, electric street cars, electric trackless trolleys, gasoline and diesel powered buses, mining cars and equipment and machine shop products.

The company has many distinguished achievements in the field of aircraft design and manufacture. First of all there was the Jetliner, which came within a few days of being the first jet propelled airliner in the world. It was an excellent machine and made a first-class showing. Unfortunately, it now seems it was abandoned in order to devote more time and attention to fighting machines.

Next, the company turned its attention to an all-weather fighter, which was required for the defence of Canada. This became the CF-100. An engine as well as a plane had to be designed. However, in the beginning the CF-100 got into the air powered by Rolls-Royce engines. It was the height of wisdom to test the new plane with proven engines rather than that a new plane and new engines should be tested together.

The history of the Orenda is a story in itself. Looking back it seems almost impossible that such a modern engine could have been built so successfully the first time the team made a try at it. Today all the CF-100's are powered with the Orenda and as well it is used as the power unit in the F-86, which is being built by Canadair in Montreal.

To do justice to what this company has accomplished would take a book at least the size of this *Journal*. This short article is not intended to be a history, but simply an acknowledgment of what this group of intrepid workers has accomplished and a tribute to them.

Here's hoping that in the next ten years the company may set up another record that will compare well with that which they have made in the last ten years.

Conference on Human Problems of Industrial Communities

The Right Hon. C. D. Howe, Minister of Trade and Commerce, has been appointed chairman of a committee to assist in selecting 30 Canadians to attend the Duke of Edinburgh's study conference on the Human Problems of Industrial Communities in the British Commonwealth and Empire.

This conference, which will take place at Oxford, England, from July 9 to July 27, 1956, will provide an opportunity for people from all parts of the Commonwealth to study the practical working of industry in the United Kingdom and to discuss their common problems and how they are being tackled. The total membership of the conference will comprise 280 men and women broadly between the ages of 25 and 45 who are engaged in the managerial, technical and labour-operative roles of industry. They will be selected from among those who now hold, or are likely to hold, positions of responsibility, and who are taking an active interest in the life of their community. The industries from which members of the conference will be drawn include manufacturing, mining, transportation and distribution.

The Canadian selection committee, of which Mr. Howe is chairman, will consist of representatives of both management and labour. The vice-chairmen of the committee are Claude Jodoin, president, Trades and Labour Congress, Ottawa, and W. S. Kirkpatrick, vice-president, Consolidated Mining and Smelting Company of Canada Limited, Montreal. In reviewing applications for membership in the conference, the committee will try to ensure that all industries and regions in Canada are represented in the group which will go to Oxford. Secretary of the Canadian Committee is A. W. A. Lane, Room A-157, No. 1 Temporary Building, Ottawa.

The Duke of Edinburgh has said: "I cannot emphasize too strongly that this is a study conference not for research workers but for young people actually engaged in industry. Its main value will not lie in the report of the speeches and discussions. Its value will depend upon what the members make of what they see and hear. Its value will lie in the ability of the members to describe their points of view and experience for the benefit of others and their ability to distinguish what is likely to be useful in their own special cases. Ultimately it is hoped that the members will be able to extend their influence in their own countries and industries to the end that industrial enterprises are so organized that they form an integral part of a happy and healthy community."

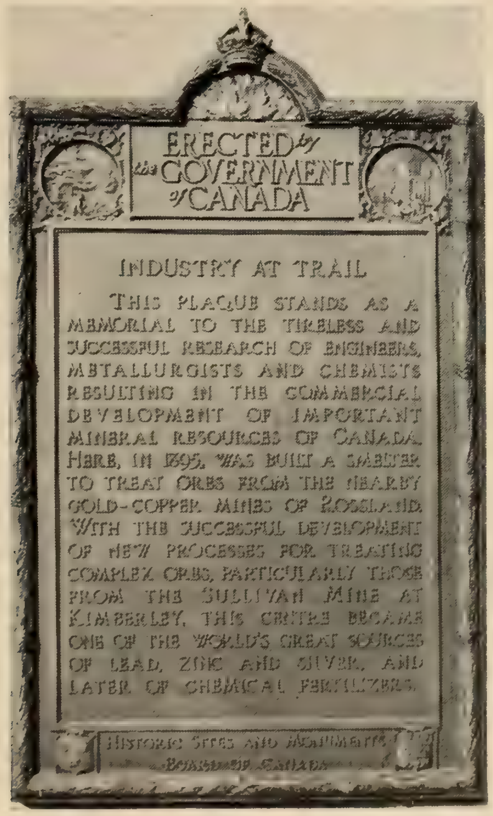
The Monument at Trail

A monument to "Industry at Trail," marking the "—tireless and successful research of engineers, metallurgists and chemists—" has been erected by the Historic Sites and Monuments Board of Canada. The plaque was unveiled by Dr. W. N. Sage, professor emeritus of history at the University of British Columbia, and B.C. representative on the Historic Sites and Monuments Board, at a ceremony held at Trail on November 19, 1955. The unveiling program was arranged by a local committee which included representatives of the district branches of the C.I.M.M., the C.I.C. and the E.I.C.

The monument is a mark of recognition afforded by the Federal Government to pioneer research and its practical application in the field of natural resource development in the Kootenays. It is the first monument ever dedicated to a modern industry by the Historic Sites and Monuments Board of Canada.

The members of the Kootenay Branch, who provided the *Journal* with this story and photographs, are particularly gratified to note specific mention on the plaque of the work of engineers. They also note with satisfaction, as did more than one official speaker at the ceremony, that the industry chosen as the first to be marked for significant research and development progress is one representing Canadian processing of domestic raw materials, with native energy resources, through to refined metals and finished chemical products. Most significant, perhaps, is the inherent recognition that the most important resource of all is trained manpower — and the recognition of the importance to Canada of men highly skilled in the physical sciences and engineering.

The erection of this unique monument, and the inscription on its plaque, should be sources of pride and justifiable satisfaction to every Institute member and Canadian engineer.



ERECTED by the GOVERNMENT of CANADA

INDUSTRY AT TRAIL

THIS PLAQUE STANDS AS A MEMORIAL TO THE TIRELESS AND SUCCESSFUL RESEARCH OF ENGINEERS, METALLURGISTS AND CHEMISTS RESULTING IN THE COMMERCIAL DEVELOPMENT OF IMPORTANT MINERAL RESOURCES OF CANADA. HERE, IN 1895, WAS BUILT A SMELTER TO TREAT ORES FROM THE NEARBY GOLD-COPPER MINES OF ROSSLAND. WITH THE SUCCESSFUL DEVELOPMENT OF NEW PROCESSES FOR TREATING COMPLEX ORES, PARTICULARLY THOSE FROM THE SULLIVAN MINE AT KIMBERLEY, THIS CENTRE BECAME ONE OF THE WORLD'S GREAT SOURCES OF LEAD, ZINC AND SILVER, AND LATER OF CHEMICAL FERTILIZERS.

HISTORIC SITES AND MONUMENTS BOARD OF CANADA

St. Lawrence Seaway and Power Project

The *Journal* reviews the news and progress of the St. Lawrence project.

Progress by Ontario Hydro

Total earth moving for Ontario Hydro's section of the St. Lawrence power project to the end of November amounted to some 6,100,000 cubic yards, indicating the progress that has been made. This includes excavation on the powerhouse site, dyke work, cofferdams, railway and highway relocation, and other phases of work.

During November the first section of the relocated No. 2 highway was opened to traffic. This 7.2-mile stretch from Cornwall to Moulinette area will divert traffic away from the construction work in the powerhouse and administration areas. A further layer of asphalt pavement will be laid next spring.

Interesting advances have been made in the construction of the new St. Lawrence transformer station. Most of the ground work has been done; the ducts are in place, while footings and foundations now are ready for equipment and structures. Some of the steel was being erected by the month end.

Cofferdam encloses excavations for power houses.

Good progress had been made on the diversion canal being constructed by C. A. Pitts General Contractor Ltd. Additional equipment had been moved to the site and with the diversion of traffic from the former No. 2 highway, a speed-up in the tempo of operations had resulted. Because of the diversion canal, a second length of access tunnels had been necessary to pass under this waterway, which will parallel the present Cornwall canal. Excavation for these tunnels had been completed; the concrete anchor pad for the steel tunnel liners has been poured, and the liners were in place by the end of November.

At the powerhouse site, excavation had been proceeding normally despite adverse weather conditions. An estimated total of more than 800,000 cubic yards of excavated material had been hauled away to the disposal area. More holes were drilled in the powerhouse area and these were grouted, using over 23,000 bags of cement for a total of some 85,000 bags to date.

Meanwhile, on the Cornwall dyke, work continued on stripping of borrow in section 2. The haul roads had been prepared and excavating the clay crossing in section 3 had started.

During November, channel improvement work progressed favourably. Removal of the western end section of Spencer Island pier to an elevation of 220.0 was completed in the Chimney Island sector. Pile driving for the bridge in the causeway to Spencer Island also was completed. A total of more than 230,000 cubic yards had been excavated to date.

Similar progress has been made on the Galops Island work, where shovels continued excavating in the main cut. Dewatering of the first excavation bay was completed and the cofferdam was increased in this area. Total excavation to the end of the month in the Galops Island area amounted to over 1,000,000 cubic yards and clearing of the island was virtually completed.

Rehabilitation work continued with little interruption at Iroquois during November despite inclement weather. A total of 55 houses had been moved to the new town site by the month end. There was much progress in laying sewers, water mains and other facilities in the new town site.

Meanwhile, at Mille Roches about 40 houses had been surveyed during the month in preparation for the development of town site No. 2. Necessary tree clearing was started and surveys completed for access roads to cross the railway at Mille Roches and Moulinette to the site of the new town.

In general, the progress of the work was outstanding during November, with some 35 major supply and construction contracts in progress. There were some 2,700 persons employed on Ontario Hydro's part of the project.

Progress by NYSPA

Progress during November was highlighted by two major achievements. On the 11th the first concrete was placed in Iroquois dam, and during the month the steel superstructure of the Barnhart bridge, connecting the island and the mainland, was completed. In addition, the total excavation quantities for all construction contracts now exceeds six and one-half million cubic yards out of a total estimated fifty million cubic yards.

In the powerhouse area, excavation was continued. More than 100,000 sacks of cement had been used in foundation consolidation and as a seal for rock excavation. While placing of embankment for the south forebay dyke had been discontinued for the winter, suitable material is being stockpiled for construction in the spring. On the river side of the main powerhouse cofferdam, steel sheet pile baffles were being reinforced to provide added protection from ice damage.

At Long Sault dam, as blocks of concrete rise in the right abutment end, and begin to define the shape of the structure, rock was being removed at the other end of the excavated area. In cut "F" excavation was accelerated as more than one and one-quarter million cubic yards of earth had been moved to date.

In addition to the placing of concrete at Iroquois dam, the driving of steel cofferdam cells progressed and earth excavation yardage reached the million mark. At the Massena intake, more than a half million cubic yards of earth had been excavated as construction of the dyke progressed.

Placing of concrete on the Barnhart bridge substructure was completed and construction of the access road and railroad on Barnhart Island was being pushed through in order to be ready to receive traffic when the bridge is opened. Steel girders now span the Grass River between abutments of the Grass River bridge, and preparations are in progress for placing concrete on the highway over the bridge.

Channel improvement excavation continued. At Red Mills Point, work progressed in spite of high water, built up by strong winds, overtopping the cofferdams. About 1,600 feet of cofferdams had been constructed in the Galop Island south channel in preparation for extensive under water excavation. A 12-cubic-yard dredge arrived and started work in the Chimney Island area.

With some 52 major supply and construction contracts in progress, production of engineering drawings and specifications continued on schedule. Specifications for channel improvements in the Sparrowhawk Point - Toussaint's Island area and emergency diesel generators were completed and issued during the month. Inspection and expediting of major items of essential equipment and materials continued to receive the priority demanded by the accelerated construction schedule. At end of November some 3,200 persons were employed on the work.

Progress by SLSA

As of November 25, on a total of 22 contracts valued at approximately $50 million awarded to date by the St. Lawrence Seaway Authority, and covering services by consulting engineers, the work completed stands at approximately 15 per cent of the total value of contracts awarded.

As winter begins to set in and the closing of navigation is announced, the 10 dredges working in Lake St. Louis and Lake St. Francis all summer and fall cease operations where they have been deepening the future channel to 27 feet. Cofferdamming in the Laprairie basin will be restricted because of the usual winter ice jam and rise of water levels. Excavation sites not clear of water cannot be worked.

Most of the work goes on, however, as winter conditions present no serious problems in the heavy earth cuts at Iroquois and Côte Ste. Catherine. Rock excavation of the overland channel at Côte Ste. Catherine and between Jacques Cartier and Victoria bridges proceeds as usual. Enlargement to piers of the Jacques Cartier bridge is carried on. About 75 per cent of the labour involved in building the navigation channel will continue working throughout the winter.

Below the Jacques Cartier bridge, where entry to the future channel will be made from Montreal harbour, Miron et Frères, Ltée. have a mile-long contract to excavate 2,000,000 cubic yards of material, of which 500,000 cubic yards are rock. Completion is called for by November 30, 1957. Excavation on this contract as of October 31 was 22 per cent completed. Considerable cofferdamming had been finished, and part of the site dewatered. Dyke construction was also progressing satisfactorily.

Atlas Construction Company had completed the water intake for the municipalities of Longueuil and Jacques Cartier. On their contract for enlargement of Piers 1 to 11 of the Jacques Cartier bridge, grouting around several of the piers was proceeding, along with work in the vicinity of Pier No. 11 in preparation for the enlargement. Work must be completed by September 30, 1956. Later, the southerly end and approaches to the bridge must be raised permanently.

On the MacNamara-Pigott-Peacock-McQuigge contract up-river from Jacques Cartier bridge towards Victoria bridge, for excavation of 1½ miles of seaway channel and dyke, due for completion by June 30, 1957, cofferdams were complete and the entire contract area dewatered. Excavation was about five per cent ahead of schedule, with about 43 per cent of the 3 million yards total removed. The dyke had been built to within five feet of finished grade throughout its length; riprap had been placed to within five feet of grade.

Tenders for the St. Lambert lock, to be built at the south shore end of Victoria bridge, were received December 20. Completion was called for August 31, 1958. This work will extend nearly a mile and will require removal of some 2,400,000 cubic yards of material. Also required will be some 400,000 yards of concrete.

The most easterly of the two channel and dyke contracts for some seven miles of channel and dyke in the Laprairie basin, to carry vessels past the Lachine Rapids, is with the Walsh-Canadian Construction Company Limited. It calls for excavation of 3.8 miles of channel and the requisite dyke, as well as construction of a turning basin for ships and the extension of the water intake for St. Lambert. Excavation required will be some 2,000,000 cubic yards of rock and nearly 5,000,000 cubic yards of common excavation, for completion by December 15, 1957.

On this contract cofferdams have been completed, a section of the channel has been dewatered, and rock excavation commenced during October. Temporary pumping facilities are now supplying water to St. Lambert. The contractor has laid 360 feet of 36-inch concrete pipe for the permanent water intake.

Adjoining this contract on the west and south is a like one, 3 miles, in length. Due for completion by August 31, 1958 it involves excavation of some 1,200,000 cubic yards of rock and some 2,500,000 cubic yards of common material. Contractor is Northern Construction Company and J. W. Stewart Limited of Vancouver. The contractor had completed some cofferdamming and about ¼ mile of channel had been dewatered. Channel excavation had been commenced and work was completed on a temporary water intake to serve Laprairie.

The work for the Côte Ste. Catherine lock and approaches was awarded to Canamont Construction Limited and Canit Construction Limited, for completion by July 31, 1958. It extends a distance of 2 miles and in addition to the lock it includes excavation of a navigation channel and dykes which form the approaches to the lock. It also includes the excavation of a turning basin downstream, regulating works for the upper reach of the canal and a reservoir pool upstream of the lock.

Common excavation required here will amount to some 2,800,000 cubic yards, rock excavation to some 1,653,500 cubic yards. Concrete work will call for some 1,750,000 bags of cement. Some 3 per cent of the material had been removed by end of October, and progress had been made in the placing and rolling of fill and raising of cofferdam.

Construction of 3/4 of a mile of the overland channel along the south shore from the Côte Ste. Catherine lock towards the Indian village of Caughnawaga, is being carried out by Miron et Frères, Ltée., for completion by November 30, 1956. This contract includes some 340,000 yards of common excavation, 490,000 yards of shale and 800,000 yards of limestone, plus the laying of 100,000 cubic yards of rock cushion on each side of the channel. The contractor here had completed the north and south cofferdams for the lock, and had removed most of the earth and shale and 40 per cent of the rock.

The last contract awarded by the authority to Northern Construction Company and J. W. Steward Ltd. at a price of $4,877,700 adjoins this one, and proceeds further overland to the Honore Mercier bridge. This excavation, some 2.8 miles in extent, will involve 2½ miles of dyke. It includes 4,600,000 cubic yards of earth and 2,900,000 cubic yards of rock, as well as cofferdams and unwatering. Work is to be completed by August 31, 1958.

Lake Channels Dredged

For dredging the seaway channel in Lake St. Louis, Marine Industries Limited have a contract for the removal of 3,800,000 cubic yards of overburden and 100,000 cubic yards of solid rock. This firm was also awarded a contract for dredging 600,000 cubic yards of sand, silt and clay from the channel at Lancaster Bar in St. Francis.

At the western approach to the Beauharnois canal, in Lake St. Francis, McNamara Construction Company Ltd. has a contract for dredging 1,100,000 cubic yards of sand, silt and clay from the Seaway channel. Canadian Dredge and Dock Company, Ltd. is the contractor to dredge 2,700,000 cubic yards of overburden from the channel from Fraser Point to Cornwall in Lake St. Francis. Two of the dredging contracts are ahead of schedule. The other two are progressing satisfactorily. About 30 per cent of the total material has been removed.

International Section

Across Iroquois Point, Pentagon Construction Company Limited and Iroquois Constructors Limited were jointly awarded a contract to construct a canal and lock. This installation will serve to carry vessels past the Iroquois control dam which will control the level of Lake Ontario. About 1 1/3 miles in length, the contract requires excavation of about 4,500,000 cubic yards of material, mostly heavy glacial till.

Approximately 26 per cent of the excavation on this contract had been completed to the end of October. Previously cofferdams had to be built at the upstream end. Work was proceeding on the erection of a concrete mixing plant and equipment repair shops had been provided.

Of some 8,300,000 cubic yards of material to be removed under dredging contracts awarded, at least 2,000,000 cubic yards or some 24 per cent, have been removed already this season, and navigation on the seaway does not begin until the opening of the navigation season of 1959.

A number of excavation contracts were not awarded until late in the summer and fall yet nearly 5,000,000 cubic yards of material had been removed on lock and channel and dyke contracts, most of which had to be unwatered first. This is some 14 per cent of the total yardage to be removed under such contracts already awarded, (but upon some of which, recently awarded, no work had yet commenced) of some 35,000,000.

The Authority has established a special lookout platform at Iroquois Point, from which may be seen the machines at work in the cut for the Iroquois lock and approaches. The work at Montreal may be easily surveyed from St. Helen's Island, from the Jacques Cartier bridge, and Victoria bridge or from the riverside drive which passes through St. Lambert.

The Authority has conducted several official tours over the works for Canadian, United States and foreign governmental representatives and for the press. It has likewise supplied the services of its officers as guides to a number of independent tours which various educational and business groups have arranged with the Authority.

Changes in Soulanges Section

It has been decided to construct separate single locks at the lower end of the Beauharnois canal, instead of the twin-flight locks contemplated under plans developed some years ago. Provision, however, will be made for the twinning of these locks in the future should the need arise.

Although the normal difference in water level between Lake St. Louis and Lake St. Francis is about 84 feet, variations in the water levels require that the locks each be designed for a maximum lift of 47 feet; otherwise, the lock dimensions will comply with the standards adopted elsewhere. To avoid interference with the flow of traffic on Highway No. 3, a two-lane tunnel will be built under the upper end of the lower lock in place of the movable bridge originally planned. This change will result in an increase in cost of about $1,100,000.

Additional facilities for which the overall first cost has been estimated at $37,320,000, will include the installation of movable spans in three existing bridges, two of which are combined highway and railway bridges and the third a railway bridge.

SLSA Hydraulic Laboratory

It is announced that Neyrpic Canada Ltd. of Montreal has been awarded a contract for the construction and verification of hydraulic models of Montreal harbour and of the Lachine rapids, and for various test programs on the models.

Two river models have already been built in the N.R.C. laboratories at Ottawa, the first to permit of an exact appraisal of the effect of the Gut dam at the head of the Galops rapids, the second for detailed studies of the most effective and economic methods required for channel improvements north and south of Cornwall Island.

The purpose of the models now proposed is to provide means for studies of the Lachine section in a manner similar to those made by the Authority and by Ontario Hydro in the international rapids section, and in regard to the Niagara development where such tests have all resulted in great economies in construction.

The Authority will construct a hydraulics laboratory building at Ville La Salle, in which the models are to be built and operated. Lalonde and Valois, consulting engineers, have been retained to prepare plans and to supervise the construction. The hydraulics laboratory and the studies and reports emanating therefrom will be under the control of a Lachine models committee, of which two members will be appointed by SLSA and two members by the model testing organization.

The Lachine rapids reach model will reproduce a nine mile section of the river from Dorval Island to below Heron Island, with a fall varying from 30 to 34 feet. The Montreal harbour model will represent the section of the river from a point ¾ of a mile above Victoria bridge to a point off Longueuil, 1½ miles below Jacques Cartier bridge.

Three contracts for enlargement of Welland canal locks were awarded by the St. Lawrence Seaway Authority on December 6 as follows: McNamara Construction Co., $359,755; Swansea Construction Company, Ltd., $698,260; and Aiken and MacLachlan, Ltd., for $104,000.

Progress by SLSDC

On the American side of the river, SLSDC has three major contracts under way on the 10-mile Sault canal, with its Robinson Bay and Grass River locks, and two dredging contracts further upstream.

At the far upstream end of the work a cross-island channel is being cut through by "The Gentleman", a huge 650 ton dragline from the Kentucky coal fields, with a 14 yard bucket on an 85 foot boom. Here the Badgett Mine Stripping Corporation has a contract for digging 3.9 million yards at a bid price of $1,372,800, less than half the Government's estimate.

Further downstream where the channel location leaves the river and cuts across-country, a Kiewit-Morrison Knudsen Joint Venture group has a contract for moving 12.5 million cubic yards of channel excavation at a price of $6,452,540. This is a dragline operation and is now well started. Two dredging contracts, for 3 million yards of earth on the Cornwall Island section and some 60,000 yards of rock in the 1000-Island section complete the work in hand on channel excavation.

Excavation for Grass River lock, a 2,500,000-yard earth excavation job, 80 feet to rock, is being carried out by the Dutcher Construction Co. at a price of $2,197,843. This lock location was moved 500 feet in planning, into a difficult marine clay material to avoid a dangerous fault line. In spite of the difficulties encountered in dewatering and in handling the sticky material the contractor has more than half completed the work and hopes to meet the February 1956 completion date.

The contract for excavation for the Robinson Bay lock further upstream, involving 2,600,000 cubic yards of earth material, was originally awarded to the Jack and Jim Maser Corp. at $990,900. After half completing the contract, the Masers defaulted in September, and it is now being finished by the Tecon Corporation of Dallas, Texas. Completion is called for early in 1956.

Awards of contracts for construction of the two locks are yet to be made. The whole project will be pushed to completion over the 1956 and 1957 construction seasons, in order that limited 14 ft. draft navigation may be possible by July 1958 at which time the old 14 foot Cornwall canal on the Canadian side is closed. As of December 1 employment stood at some 450.

Canadian Seaway Authority officials visited Washington, D.C., December 8 and 9 for meetings with the Saint Lawrence Seaway Development Corporation for further discussions on the Polly's Gut bridge and allied matters in the international rapids section. Discussions regarding tolls were carried on between the two tolls committees, United States and Canadian, which are studying this subject and

London Meetings

Above. The opening of the International Conference on Combustion. Left to right, Sir Ernest Smith, R. E. Heartz, D. M. Watsin, P. L. Jones, B. G. Robbins, J. D. Peattie and Prof. O. A. Saunders.

President R. E. Heartz and the general secretary visited Britain in October and took this opportunity to entertain overseas members of the Institute, at headquarters of the Institution of Mechanical Engineers. Below left. Old friends at the E.I.C. reception: Sir David Pye, past-president, I. Mech. E., Dr. Heartz, Allan Quartermain, and Sir John Hacking, past-presidents of I.C.E.; Brian Robbins, secretary of I. Mech. E.

reporting from time to time thereon.

Canal Redesigned

The Canadian and United States governments have announced agreement with a scheme of the International Joint Commission for toning down extremes of high and low water in Lake Ontario. It is a plan for protecting perennially-threatened shore areas in the Montreal district by redesigning part of the St. Lawrence seaway canal there.

External Affairs Minister Pearson has made public a letter approving the I.J.C. plan. "Arrangements now have been made," he said, "for the redesign of a portion of the new 27-foot canal in the vicinity of Montreal, which will allow a flow of 40,000 cubic feet per second to be bypassed from Lake St. Louis to Laprairie basin through the canal during the non-navigation season.

"This will not only provide more favourable ice-forming conditions in the narrows between Lake St. Louis and Laprairie basin . . . but should also be of benefit to upstream interests on the St. Lawrence River and Lake Ontario."

Thirty-five Years Ago

Comment on the *JOURNAL* of January 1921

The *Journal* started off for 1921 with an issue in January somewhat plumper than most of its predecessors. A large part of the increase was in the advertising pages, where several new names may be noted, including some still with us.

I am told that the *Journal's* uprise in advertising was because it had acquired a full-time solicitor, S. A. Neilson, M.E.I.C., now on the staff of the faculty of engineering of McGill University.

Not all of our 1921 advertising patrons have lasted out the years, e.g., Armstrong-Whitworth, Ltd., which offered a great array of products ranging from brass rod to diesel engines. Its plant was in Longueuil, across the river from Montreal, and was probably the first in Canada to use pulverized coal as a metallurgical fuel.

The company's managing director was the late M. J. Butler, M.E.I.C., a choleric Irishman. I well remember riding over the Victoria Bridge with him long before it was widened, in his Armstrong-Siddeley car, a vehicle as long and unwieldy as many a small truck. Half-way across we met a farmer with a load of hay. No amount of squeezing and jockeying would allow us to pass, so Mr. Butler gave his chauffeur $20, he bought the hay and the farmer pitched it over the rail into the St. Lawrence. We passed.

Annual Meeting Papers

The technical papers in this *Journal* were all preprints of some to be presented at the *Institute's* annual meeting to be held in Toronto in February. The first was a design of a sewage disposal plant for a seaside city, by C. J. Yorath, A.M.E.I.C.; the *Journal* had not yet adopted the practice of identifying authors by their professional connections. The paper dealt with an hypothetical city and conditions, but the design was worked out in considerable detail, some of the computations being given in extenso.

J. C. Keith, A.M.E.I.C., followed with a paper on "Cost-plus Contracts". I wonder if this is the J. Clarke Keith for whom the Ontario Hydro's steam generating station in Windsor is named? I was surprised to learn that cost-plus contracts were quite novel in 1921, one of the earliest in America dating back only to 1907, according to Mr. Keith. Admitting that there are disadvantages in the cost-plus system, the author made out a pretty good case in its favour, citing a sewer contract where the final expenditure under cost-plus was about 20 per cent less than the lowest lump sum tender received.

Then one of our few chemical engineering members, L. E. Allen, M.E.I.C., discussed "Hydrated Lime". He pointed out that our chemical industry used more than one-half of our production and that the rest went mostly into civil engineering works as a constituent of mortar and plaster and as an additive to concrete, as a plasticizer and waterproofer. He wrote of the water-cement ratio as being "now well established as governing the strength of concrete" and strongly advocated the use of up to 10 per cent of hydrated lime in concrete to allow of the reduction of this ratio without loss of concrete strength or of work ability. We still use some hydrated lime in concrete, but not as much as Mr. Allen thought we were going to.

James Milne, M.E.I.C., had a paper in this *Journal* on the Toronto filtration plant, comparing the operation of the 1912 slow-sand filters with that of the 1917 drifting-sand filters. Both gave a perfectly satisfactory water, but the cost per million gallons of water filtered was higher for the latter than for the former. At any rate, when Toronto built a new filtration plant not many years ago, it did not use the drifting sand type.

Mr. Milne's paper was followed by one by E. A. Ryan, A.M.E.I.C., on the heating and ventilation of paper-machine rooms, with a long discussion by E. A. Briner, M.A.S.M.E. The two together gave an excellent picture of the state of the art then; I doubt if it has changed much in thirty-five years.

Personalities

The rest of the editorial matter deals with plans for the forthcoming annual meeting, a special nomination of H. G. Acres, M.E.I.C., for the post of vice-president—and a plea to the government to appoint an engineer to the Railway Commission.

Among the personals, I find that A. G. L. McNaughton, A.M.E.I.C., was on his way to England for a year's visit and that R. L. Weldon, JR.E.I.C., had just become mechanical engineer for the Three Rivers Pulp & Paper Co. The first is, of course, Gen. A. G. L. McNaughton, now chairman of the Canadian Section of the International Joint Commission and Mr. Weldon is president of the Bathurst Power and Paper Company.

One member is announced as having set up as a contractor in Toronto, in which business he "expects to continue . . . for some years to come". Don't they all?

The late J. M. R. Fairbairn, M.E.I.C., was the incoming president, so his portrait appeared in the *Journal*, a determined looking young man, but without the imperial bearing so characteristic of him in later life.

The Battlefields Memorial Commission, of which Col. R. W. Leonard, M.E.I.C., was a member, announced a design competition for the monuments it proposed to build at St. Julien, Courcelette, Vimy Ridge, Passchendaele, Hospital Wood, Dury Cross Road and Bourdon Wood, all points where Canadian troops helped to win Allied victories in the late war.

The Branches

Life in the branches seemed to be going along about as usual. Metering of a selected area in Halifax had cut water consumption down by about 65 per cent, but it was complained that building laws and plumbing regulations were hard to enforce on account of civic politics."

The Ontario Provincial Division was still trying to get an engineers' licensing act passed in that province and after a good bit of apparently acrid discussion, authorized its committee on the matter to use all legitimate means to forward such legislation. The Vancouver Branch was concerned because it was rumoured that "certain powerful interests propose . . . to endeavour to have certain amendments enacted, eliminating the compulsory clauses of the Engineering Profession Act."

The *Institute* was growing; there were an even hundred applications for membership published in this *Journal* and 17 for transfer.

Engineering Careers in Canada

On page 89 of this issue readers will find the first of three articles that will appear in the *Journal* covering the role of the engineer in the Canadian armed forces. Our purpose in publishing them is twofold, first, to inform readers of what the members of our profession are doing in the defence of Canada, and second, to help the services in their search for new technical personnel. It was our intention to run these stories according to established custom with the navy coming first. However, to save time, and with proper apologies to the sailors, they will appear in the order they are being received from Ottawa.

It is proposed to continue with a further series of articles on similar lines about careers in various fields of Canadian industry.

Annual Meeting of R.C.E.M.E Corps Association

The R.C.E.M.E. Corps Association held its tenth annual general meeting and dinner at the R. C. E. M. E. School, Barriefield, Ontario on October 22 last.

The president, Lieut.-Col. A. G. Edward of Montreal, was re-elected for a second term, while the honorary secretary-treasurer, Lieut.-Col. LeSueur Brodie of Toronto was also re-elected. Lieut.-Col. J. K. Bradford of Toronto was elected first vice-president.

Guest speaker at the annual dinner was T. W. Eadie, M.E.I.C., of Montreal, president of the Bell Telephone Company of Canada Limited. A special feature of the dinner was the presentation to Gen. The Hon. A. G. L. McNaughton, M.E.I.C., honorary colonel commandant of the Corps of the Canada Decoration with two clasps, by Col. J. R. Dunlop, M.E.I.C., director of the Corps.

Delegates who attended the meeting and dinner were Lieut.-Col. E. D. Gray-Donald, M.E.I.C., chairman, Quebec Command chapter; Maj. O. B. Berringer, M.E.I.C., chairman, Eastern Command chapter; and Maj. L. Raisbeck representing Western Command chapter. Besides those mentioned above the following unit officers were present: Col. C. W. Jones, M.E.I.C., commanding the R. C. E. M. E. School, Barriefield; Lieut.-Col. L. Martin, M.E.I.C., commanding 3 Technical Regiment, Montreal; Lieut.-Col. L. M. Harding, commanding 4 Technical Regiment, Toronto; Maj. A. Anderson, 5 Technical Regiment, Hamilton; and Maj. O. Dunn, 6 Technical Regiment, Windsor.

R.C.E.M.E. Corps Association Meeting

Elections and Transfers

At the meeting of Council held at headquarters, on Friday, December 16th, 1955, a number of applications were presented for consideration and on the recommendation of the Admissions Committee the following elections and transfers were effected:

Members:

J. S. Arczynski, *Toronto*
W. L. Gross, *Montreal*
A. Mackie, *Toronto*
J. W. L. Monaghan, *Toronto*
E. M. Monteith, *Toronto*
J. E. Sutton, *Victoria*
E. I. Wigdor, *Montreal*
S. Wood, *Ottawa*

Juniors:

J. B. Laurie, *Montreal*
B. P. Nicholls, *Montreal*
J. R. Wells, *St. John's*

Transferred from the class of Junior to that of Member:

P. J. Boivin, *Kenogami, Que.*
N. E. Duncan, *Montreal*
G. Ewing-Chow, *Georgetown, B.G.*
J. L. Gariepy, *Sorel*
W. S. Jones, *Houston, Texas*
W. C. Leith, *Montreal*
M. H. Margles, *Toronto*
J. H. C. Massie, *Toronto*
A. R. D. Robertson, *Victoria*
G. C. Robinson, *Saint John*
T. E. Smith, *London*

The following Students were admitted:

McGill University

J. Achtman
G. J. Akamoto
R. J. Allore
H. L. Atkinson
G. Banks
F. Barna
R. G. Begley
R. E. Belair
P. R. Belanger
G. Bellefleur
D. Bohonos
G. Boulais
J. E. Buchan
I. A. Burla
J. R. G. Collard
H. C. Clowes
G. T. Connery
C. H. Cormier
T. A. Crooks
R. H. Crosbie
A. S. Derrick
L. De Simone
W. D. Duanne
W. E. Dunford
Y. C. Dupuis
D. J. P. Evans
V. V. Filipovich
G. L. Fox
B. Garceau
F. E. Godwin
V. Golde
S. Greenberg
F. A. Guilbault
J. R. Hall
J. M. Hammel
F. J. P. Heffernan
R. G. Hollett
B. A. Howarth
H. M. Ichiyen
C. K. Januskevicius
J. H. Johnsen
L. T. Kishino
A. Klicius
R. S. Knott
H. F. Kolodny
H. I. Kornbluth

A. Lipes
R. G. Lubelsky
L. J. Luyks
C. J. E. MacKay
P. G. Mackay
H. A. Macpherson
A. A. McAlear
J. G. M. McKirdy
R. K. McNamee
V. de P. Marceau
D. M. Martin
S. R. Mester
A. Miroshnichenko
W. G. Montgomery
D. R. Morrier
W. H. Moulton
F. S. E. Murphy
J. Mushka
F. S. Nemet
M. Novac
A. Novakoff
P. Ostapeic
J. Ozers
J. F. L. Pelletier
R. Picard
C. R. Pilon
A. L. Poddubny
E. V. M. Prives
W. C. Ramsden
G. A. D. Reed
D. W. Reesor
R. I. Robertson
A. A. Robillard
J. A. Rowley
V. Schecter
D. M. Smith
W. J. Smith
M. A. Sochocky
T. de G. Stewart
S. Sura
J. Terauds
G. G. E. Trudel
C. Villeneuve
J. J. Vincent
T. J. Wagg
D. Wainberg

W. Larson
R. S. Leiffer
E. V. Leon

G. R. A. Weiss
M. Werbin

University of Manitoba

B. E. Akins
V. M. Austford
R. N. Ayukawa
K. A. Bailey
T. L. Blais
F. R. Bruckner
D. G. Burdeny
G. Call
G. F. Carleton
J. G. Carruthers
R. G. Caughey
B. Chan
G. Chymko
L. A. Clay
W. D. Crowe
E. P. Debusschere
E. Dolhun
W. J. L. Duncan
G. Dyck
C. Feuer
T. C. Fraser
T. A. Ferens
G. E. Grant
M. Gumprich
R. S. Hayward
R. A. Hewett
D. M. Heys
E. W. T. Hnatiuk
A. G. Hook
B. R. Hryhorczuk
L. E. Hurwitz
B. M. Jacobs
L. R. Jacobson
E. Kaarsoo
H. Kowaalik
G. J. Lapointe
P. Leung
C. G. Luckman
M. F. Macpherson
T. Maftechuk
W. R. Martin
J. A. Martino
J. M. Moore

L. R. McGinnis
F. T. McGregor
D. G. McKenzie
W. J. McQuay
I. A. Nattress
D. K. Newey
Y. Okamura
E. M. Pashniak
J. S. Paulsen
B. O. Pedersen
F. Penner
B. C. Peterkin
L. Petrie
G. G. Phillips
E. Pollock
A. F. Potter
V. R. Price
A. Priestley
J. W. Puchalski
I. Reinhart
D. J. Rennie
N. Richards
H. P. Rostig
H. J. Schleier
L. F. Schmidt
J. P. Sharby
D. M. Shook
D. B. Sigurdson
P. R. Simmonds
L. R. Smith
W. W. Starr
J. A. Stewart
S. P. S. Sulymka
R. D. Sweeney
A. R. Szewczyk
M. Tennenbaum
R. P. Tomlinson
W. J. Tischinski
R. C. Verner
J. T. Woods
R. J. Wright
V. A. Yamasaki
W. K. Zimmerman

University of Toronto

J. D. Acheson
D. A. Allen
D. C. Brownlow
G. N. Hesler
G. R. Howland
J. R. Inglis
P.Kalnins
R. Kurkjian

D. K. L. Kwong
J. C. Pickett
T. B. Seawright
R. E. Stone
F. T. White
H. O. Wieler
G. T. Will
S. W. P. Wyszowski

University of Alberta

H. G. Basler
F. F. Beck
D. M. Carlisle
J. J. Chilibeck
H. K. Hanson
T. E. Horne

M. A. Kehr
F. Lukawitski
H. Nahaiowski
F. T. Russell
E. L. Taylor
D. M. Walker

Nova Scotia Technical College

D. R. Bourke
A. J. Comeau
J. W. W. Fawcett

J. O. Hachey
J. C. Sinclair

University of New Brunswick

A. W. Gibson
D. H. D. Jackson

R. H. MacIntosh
H. H. Sherrard

Carleton College

K. E. Gardiner
W. G. Halvorson

Loyola College

R. K. Cox
S. M. Perrotta

Lakehead Technical Institute

G. W. Brown
R. T. S. Nash

Mount Allison University

G. W. Hannah

Graduates

L. Richard, B.Eng. (Mech.) 1955, Toronto.
K. E. Newbold, B.A.Sc. (Engrg. Physics) 1955, Toronto.
J. M. Neal, B.A. Sc. (Engrg Physics) 1955, Toronto.
J. D. Crickmore M.Sc. (Mining) Stanford 1955.

Applications through Associations:

By virtue of the co-operative agreements between the Institute and the Associations of Professional Engineers, the following elections and transfers have become effective:

ALBERTA

Members:

R. F. Andretsch
K. G. Clarke

Junior to Member:

W. D. Usher
J. Steudel

SASKATCHEWAN

Members:

L. S. Earp
F. A. Kidd
J. H. Lapp
R. L. McPherson

B. C. Palmer
D. R. Rowe
P. R. Wilson

Students:

H. R. Akehurst
D. Bartkiw
D. W. Bishop
S. T. Bramwell
S. S. Brkich
M. Cherney
E. W. Chornomydz
J. I. Daniels
S. I. Deckert
M. J. Demetrick
G. C. M. Derbowka
E. J. Dueck
J. A. A. Field
D. G. Fisher
T. B. Fletcher
F. W. Fossey
D. M. Galbraith
F. K. Gerbrandt
T. P. Gilchrist
R. W. Gillanders
W. H. Glaister
A. A. Gorkoff
H. M. Hleck
E. A. Hodgins
L. A. Kaeding
H. J. King
J. S. King
B. W. Kischuk
G. Kobelak
P. Kozicki
Paul Kozicki
R. B. J. Kroeker
G. E. Laliberte
D. L. Lawrysyn

J. J. Lipsett
R. L. Mackenzie
J. W. MacNeill
F. D. McCarthy
J. M. McNeil
A. W. Millard
L. C. Miller
F. W. A. Mosienko
M. M. Muth
G. T. Narfason
G. G. Popoff
W. A. Posehn
V. A. G. Rein
V. L. Ryhorski
R. Schindelka
H. Schmidt
K. G. Schoenroth
W. J. Serne
A. C. Shuster
R. O. Sochaski
J. R. Stoffel
G. R. Straub
J. A. Thom
K. H. Thompson
M. B. Todd
L. E. Torfason
J. L. Townsend
S. S. Turek
S. D. Walker
D. J. Walsh
M. W. Weddige
E. G. E. Wurts
T. Yoshida

Junior to Member:

J. T. Dokken
R. M. Heaton

K. J. MacRae

MANITOBA

Junior:

W. Naumko

NOVA SCOTIA

Members:

D. R. Downing
J. C. Eaton

Junior to Member:

A. M. Macdonald
D. E. Rudolph

Correction

In the December 1955 issue of the *Journal*, page 1693, under "Elections and Transfers"—Council Meeting of November 19, 1955, through a clerical error Mr. J. E. Wright, Toronto, was shown as a Member, whereas he was elected a Junior.

NEWS OF THE ASSOCIATIONS & CORPORATION

Information received through co-operation with the provincial organizations

Ontario

News of the Members

H. W. Tate of Toronto has been promoted from executive vice-president to president of De Leuw, Cather and Company of Canada, Ltd. at a recent meeting of the company which is associated with De Leuw, Cather and Company of Chicago.

De Leuw, Cather and Company of Canada Ltd., located at 52 St. Clair Avenue East, Toronto, was formed early in 1954 and at present employs nine professional engineers. Prior to joining this firm of consultants, Mr. Tate was assistant general manager of the Toronto Transportation Commission with which he had been associated for many years.

Norman A. Grandfield is now manager of the Public Utilities Commission of Brantford, Ont. A graduate in electrical engineering of Queen's University, Mr. Grandfield was formerly manager of the Public Utilities Commission of the City of Galt.

Donald H. MacDonald is on the engineering staff of H. G. Acres and Co. Ltd., of Niagara Falls, Ont.

Fred H. Edwards, formerly with the Canadian Westinghouse Company in Hamilton, is now assistant professor of electrical engineering at the University of Massachusetts, Amherst, Mass.

Professor Edwards graduated in electrical engineering from the University of British Columbia in 1949 and joined Westinghouse at that time. While with the Canadian Westinghouse he undertook post-graduate work and received a master's degree in electrical engineering from the Nova Scotia Technical College. He was appointed to the staff of the University of Massachusetts early this fall.

John W. Emerson is now engaged in the private consulting practice of John Emerson and Associates with Cleveland office at 1277 Ramona Avenue, Lakewood, Ohio.

Mr. Emerson graduated in engineering from the University of Toronto in 1930 and two years later obtained his master's degree. Before moving to the United States several years ago he was with John Inglis Company in Toronto

Robert B. Jennings, who was formerly claims and contract engineer with the Trans-Canada Highway division, Department of Public Works, is now associated with the Department of Planning and Works of the City of Ottawa

Dr. W. C. Winegard and **Dr. J. W. Rutter,** of the Department of Metallurgy of the University of Toronto, took part in a recent Canadian symposium on melting, diffusion and related topics. The meeting was held in Ottawa, under the auspices of the low temperature and solid state physics group of the National Research Council, to bring together scientists from Canadian research institutions and universities interested in various aspects of the problems of melting and the liquid state.

T. N. McLenaghan, of the Abitibi Power and Paper Company, Ltd., has been transferred from the Fort William division, where he was control superintendent, to the Iroquois Falls division of the company as assistant to the mill manager.

Dusan Lazarevich and Associates, Toronto consulting engineers, have moved to new offices at 244 Dupont Street, Toronto. We are informed by **D. P. Lazarevich** that the new phone number is WAlnut 10-6631.

Brian A. Tucker, of Canadian Westinghouse Co. Ltd., has been moved from Hamilton where he was employed as contract administrator, to Montreal, where he is senior technical representative of Westinghouse in one of the plants of Canadair, Ltd.

C. A. Dunham Co. Appointment

Announcement has been made by **A. J. Dickey**, president of C. A. Dunham Co. Ltd., of the election of **Richard M. Mitchell** as executive vice-president and assistant general manager of the company.

A graduate in engineering of Queen's University and also of the Harvard School of Business Administration, Mr. Mitchell has been actively connected with the heating and air conditioning industry for the past seven years. During the Second World War he served with the Royal Canadian Engineers, retiring with the rank of lieutenant-colonel.

H. C. Schwegler is now associated with the Dominion Electric Manufacturing Co. Ltd., of 60 Leslie Street, Toronto. He was formerly engaged in sales engineering with D. M. Fraser Ltd., of Toronto.

A. J. Vale has resigned from the employment of H. G. Acres and Co. Ltd., of Niagara Falls, Ont., to join the Atomic Energy of Canada Ltd., Deep River, Ont., as a design electrical engineer.

Heads National Carbon

The appointment of **John S. Dewar** as president of The National Carbon Company, a division of Union Carbide Canada Ltd., Toronto, was announced recently.

Mr. Dewar is a graduate in chemical engineering of Queen's University, and has been with National Carbon since 1943.

Lt. Col. R. H. Milne, of Toronto, has recently completed his tenure of command of the 2nd Field Engineer Regiment, R.C.E., whose headquarters are in Fort York Armouries, Toronto. Succeeding him in commanding the Regiment is **Lt. Col. A. G. Keith,** M.R.I.C.A., who is associated with A. D. Margison and Associates Ltd., of Toronto.

Colonel Milne graduated in civil engineering from the University of Toronto in 1941 and saw extensive service during the Second World War. He joined the 2nd Field Engineers Regiment shortly after return from overseas and was given command in 1952. He is chief engineer of the Department of Buildings for the City of Toronto.

W. E. Ewens has announced the opening of a consulting engineering practice in transit planning and traffic engineering. His offices are located at 462 Morrison Road, Oakville, Ont. Services offered in the transit field include long range and immediate planning, route studies, costs and all forms of transit research, particularly as related to smaller transit properties. Traffic services include all phases of traffic engineering, surveys and consultations.

Mr. Ewens is a graduate in civil engineering of the University of Toronto, and was with the Toronto Transportation Commission, as research engineer. He is a director of the Canadian Section of the Institute of Traffic Engineers.

Geoffrey C. Winkler has resigned his position as methods engineer at the Ford Motor Co. of Canada Ltd., Windsor, Ont., to accept a position as industrial-mechanical engineer with ACF Electronics, a division of American Car and Foundry Industries Inc., in Alexandria, Va.

Alberta

E.S.S. Plans Busy Year

Hugh Atkins, president of the Engineering Students' Society, when interviewed stated that they now have a membership of 670 students. This excellent percentage of the total student class speaks well for the membership campaign of the E.S.S.

Roy Mutter, secretary of the E.S.S., stated that a full program of monthly meetings was planned as well as many special events. The annual smoker, which has already been held, was extremely successful this year, with everyone on his best behavior.

First on the list of special events will be the annual Engineers-Nurses dance, a charitable undertaking, the proceeds from which go to the World University Service. In January the annual Engineers' Ball and Queen Contest will be held. This is the highlight of the E.S.S. program. Atkins stated that the Queens this year would be the most beautiful ever and that the model engineering displays would be the most outstanding to date.

In February and March the regular meetings will feature papers presented in the Webb Memorial Student Paper Competition. This competition, which is held in honour of the late Professor Webb, offers prizes of $25.00, $15.00 and $10.00 for the best papers presented to the E.S.S. during the regular term.

Finally, to complete the year, the annual Engineers' Banquet will be held in March.

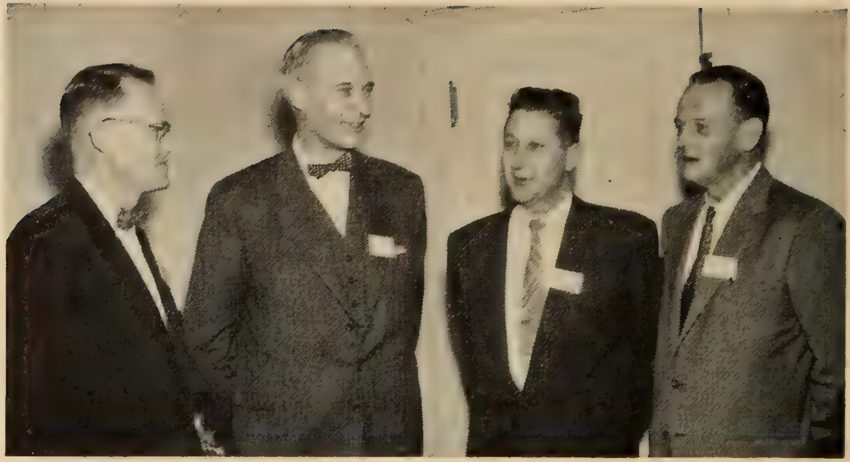
Our interview with Hugh Atkins and Roy Mutter was too short to cover sports and other activities in which the engineers take part, but from what was learned it appeared that E.S.S. is, if anything, bigger and better than many readers will remember from their university days.

(Reprinted from *The Alberta Professional Engineer*, Nov. 1955.)

British Columbia

Annual Meeting in Victoria

Three hundred members and engineers-in-training affiliated with the Association of Professional Engineers of B.C. attended the two-day convention and annual meeting in the Empress Hotel, Victoria, on December 2 and 3. It was the first time the meeting had been held away from Vancouver since the Association was formed in 1920, and approximately 50 per cent of those present came from outside Victoria. Also in attendance were representatives of four other provincial Associations of Professional Engineers: E. W. Christian and A. E. McDonald, from Alberta; R. Bing-Wo, Saskatchewan; W. J. Patton, Manitoba; and Col. T. M. Medland, executive director of the Ontario Association.



Discussing their new duties are some of the members of the 1956 Council of the Association of Professional Engineers of British Columbia at the Association's annual convention held at the Empress Hotel, Victoria, on December 2 and 3. Left to right: W. O. Richmond, vice-president; J. E. Liersch, president; M. A. Thomas, all of Vancouver, and A. J. Saunders, Victoria.

C. D. Howe Addresses Luncheon

The Rt. Hon. C. D. Howe, Minister of Trade and Commerce, addressed an overflow audience at the annual luncheon on December 3. Mr. Howe said preliminary surveys of investment plans indicate that capital expenditure by governments and business in 1956 will be at least as high and probably higher than for the current year, and that this prospective expansion is not limited to any one area but seems to extend from coast to coast. He went on further to say that building activities during 1956 were more likely to be limited by shortage of materials than by a shortage of available capital. He warned, however, that there is no room for complacency, and advised that we have not yet been completely successful in mastering the problem of combining stability with progress.

J. E. Liersch Is New President

J. E. Liersch, vice-president of the Powell River Company, a forest engineer, was installed as president of the Association. He succeeds Dr. H. C. Gunning, dean of the Faculty of Applied Science at the University of British Columbia, who will serve another year on Council as past president. Elected as members of Council for 1956 were Professor W. O. Richmond, vice-president; A. C. Buckland, F. A. Lazenby, R. R. McNaughton, A. J. Saunders, and M. A. Thomas. Four additional members of Council will be appointed by the British Columbia Government.

Awards

At the annual awards luncheon on Friday, December 2, the Association Gold Medal was presented to F. S. Death, as the student in the 1955 graduating class at the University of British Columbia whose undergraduate record was considered by the Faculty to be most outstanding.

The Letson Memorial Prize, donated in memory of his father by Major-General H. F. G. Letson, C.B.E., M.C., E.D., for the best report or thesis submitted in support of an application for registration as a mechanical engineer, was awarded *in absentia* to N. L. Williams for his report "The Comparison Tower Concept for Predicting Cooling Tower Performance". Mr. Williams is at present on loan from the B.C. Electric Co. to the Chalk River development.

The Association Book Prizes of $25.00 value, which are annually awarded to engineering undergraduates in 3rd year Applied Science, will be presented during the president's visit to the campus next spring. Winners are: R. A. Sterne, chemical; J. J. F. Loewen, civil; W. N. Junas, electrical; K. H. Darke, geological; and E. Hay, mechanical.

The Ingledow Prizes, donated by T. Ingledow, for general proficiency in each year of engineering at the university, went to: W. R. Rasmussen; T. F. Somerville; J. J. F. Loewen; and L. G. Maranda.

Life Membership medallions were presented to: G. M. Irwin, Victoria; G. P. Sharpe, Salmon Arm; and W. Jamieson, Westview.

The president then called upon those about to receive certificates of registration and reminded them that they were publicly entering upon the privileges and responsibilities of a great profession; that they were bound by the same code of ethics as all professional engineers and that they must preserve the tradition of the profession faithfully as their most cherished possession. Certificates were then presented to the following: W. R. Cheriton, Vancouver; E. I. Dery, D. Logan, and D. G. Sutherland, all of Victoria; P. H. H. Hookings, and J. A. Procunier, of Vancouver; B. R. MacFarlane, of Port Alberni; H. M. Thurgood, of Campbell River; and Z. Wolski, of Westview.

In a special ceremony at Jubilee Hospital, Dr. Gunning, accompanied by Mr. Liersch and Registrar J. A. Merchant, presented a certificate of registration to A. C. Packard, who had been stricken with polio and was unable to attend the luncheon.

In addition to two days of business sessions there was a full program of social events, including two morning coffee parties and a Friday evening banquet for the 70 ladies who accompanied their husbands to the convention. For the men there was the annual stag party

(*Continued on page 106*)

Obituaries

The sympathy of the Institute is extended to the relatives of those whose passing is recorded here.

Frederick William Cowie, M.E.I.C., retired chief engineer of Montreal harbour, died in Montreal on October 30, 1955.

Mr. Cowie was born in Caledonia, Ont., on March 27, 1863. He received his education at Woodstock College and graduated from McGill University in 1886 with a B.A.Sc. degree in civil engineering. While at Woodstock College he studied special courses in mathematics and astronomy and spent his summer vacations as assistant in charge of the Astronomical Observatory there, and also worked on the survey of the Niagara Falls Park Commission. Upon his graduation from McGill he was employed as assistant engineer with the Montreal Harbour Commission, working on the St. Lawrence ship channel.

In 1908, Mr. Cowie was one of a group of engineers who made extensive surveys of the principal harbours of Europe and the United Kingdom. This knowledge was put to use by Mr. Cowie during the first world war when he was sent as a consultant to Halifax where harbour expansion was underway. He was also responsible for planning the steady flow of grain shipments out of Halifax and Montreal at that time.

Mr. Cowie retired as chief engineer of the Montreal Harbour in 1926, having attained that position in 1907. After his retirement he was actively engaged as a consultant on major harbours including those at Norfolk, Va.; Boston, Mass., and Havana, Cuba.

In 1914, Mr. Cowie received the Telford Medal of the Institution of Civil Engineers for a paper entitled "Transportation Problems in Canada and Montreal Harbour." More recently, he compiled the book, "Tales of the St. Lawrence," which is a series of incidents and stories connected with the River.

He was a member of the American Society of Civil Engineers. Mr. Cowie joined the Engineering Institute in 1887 as an Associate Member and transferred to Member in 1898. He attained life membership in 1933.

George A. Kydd, M.E.I.C., retired civil engineer in Ottawa, Ont., died suddenly in Kentville, N.S., on October 25, 1955.

Mr. Kydd was born in Montreal on November 20, 1883, and attended Montreal public and high schools. He graduated from McGill University in 1905 with a B.Sc. degree in civil engineering.

Upon graduation he joined the Grand Trunk Railway as assistant engineer in charge of construction of a grain elevator in Midland, Ont., and then was also with the National Transcontinental Railway in New Brunswick for a time, and with the Canadian Pacific Railway. In 1913 he joined the Department of Railways and Canals and was engaged on work on the Trent Canal in Campbellford, Ont. In 1924 he became divisional engineer on the Welland Canal, and then in 1932, resident engineer on Hudson Bay Terminals for the Department of Transport in Churchill, Man., subsequently coming to Ottawa as district engineer. He retired from the Board of Transport Commission in 1953.

Mr. Kydd joined the Engineering Institute in 1902 as a Student, transferred to Junior in 1911, to Associate Member in 1914, and to Member in 1940. He attained life membership in 1947.

Hector Somerville Philips, M.E.I.C., president of Philips and Roberts, consulting engineers of Hamilton, Ont., died suddenly of a heart attack in Port Colborne, Ont., on October 20, 1955.

Mr. Philips was born in Airdrie, Scotland, on November 20, 1882, and was educated at Wigan High School, Lancashire, England, and at Heriot-Watt College in Edinburgh.

Mr. Philips was employed as assistant engineer on various waterworks in Scotland before coming to Toronto in 1911 as draughtsman with the City of Toronto working on the design of sewerage and sewage disposal works, and then as engineer on sewage design. In 1915 he joined the staff of Professor E. B. Phelps, consulting sanitary engineer of the International Joint Commission in connection with the pollution of boundary waters, and the following year became designing engineer for Canada Nitro Products Company Ltd. in Toronto, in which capacity he supervised the design of a sharpnel loading plant. From 1916 to 1919 he held a commission as a lieutenant in the Royal Canadian Engineers.

In May, 1920, Mr. Philips was named engineer-in-charge of sewer design for the City of London, Ont., and the following year was named to the similar position with the City of Hamilton, Ont., subsequently becoming designing engineer. After twenty-three years service, in 1944, Mr. Philips retired from this position to establish the firm of Philips and Roberts, consulting engineers in Hamilton. At the time of his death he was president of this company.

Mr. Philips joined the Engineering Institute in 1915 as an Associate Member and transferred to Member in 1922. He attained life membership in 1951.

Charles H. Pinhey, M.E.I.C., construction engineer, died in Ottawa on November 6, 1955.

Mr. Pinhey was born in Ottawa on March 20, 1867, and was educated at Ottawa Collegiate Institute (now Lisgar Collegiate). He graduated from the School of Practical Science, Toronto, in civil engineering in 1887. The following year he passed examinations for Ontario Land Surveyor, and in 1889, for Dominion Land Surveyor. He was employed by the Department of Railways and Canals as rodman, leveller, and surveyor on the Soulanges Canal from 1889 to 1896, and for the next five years, as engineer for Manning & Macdonald, also working on the Soulanges Canal. He also spent some time as engineer on construction of a wharf at Three Rivers, Que., and then subsequently retired from active engineering practice to manage his personal property.

Mr. Pinhey joined the Engineering Institute in 1887 as a Student, transferred to Associate Member in 1894, and to Member in 1940. He attained life membership in 1947.

William O. Marble, M.E.I.C., partner in the engineering firm of Hodgson, King and Marble in Vancouver, B.C., died on August 27, 1955 in Vancouver.

Born in Hampstead, New Hampshire, he received his general education in Haverhill, Mass., and then studied engineering under private tutors. He spent five years as a draughtsman and resident engineer with the city engineer's office at Haverhill, Mass., and then in 1900, eight years on the engineering staff of Purdy Henderson, New York, working on the design of structural steel. Mr. Marble was then transferred to Boston by the company and was in charge of their engineering office in that city. From 1909 to 1917 he was western manager of Purdy Henderson (Canada) with headquarters in Vancouver, B.C.

In 1917 Mr. Marble entered into partnership with Hodgson and King as consulting engineers in Vancouver.

He was a member of the Association of Professional Engineers of British Columbia, and served on the board of examiners of the structural branch of that association.

Mr. Marble joined the Engineering Institute in 1919 as a Member, and attained life membership in 1950.

Alfred E. Hopper, M.E.I.C., retired steamship inspector, died in Ottawa on November 13, 1955.

Born in Darlington, England on July 20, 1870, Mr. Hopper received his general education there. He spent six and a half years as an engineering apprentice with the North Eastern Railway Company in Darlington before coming to Canada in 1891 and joining the Grand Trunk Railway Company in Montreal. The following year Mr. Hopper became an engineer on a ship and travelled extensively for several years.

In 1910 he was named steamship inspector at Vancouver, B.C. Mr. Hopper came to Ottawa in 1919 as principal inspector of boilers and machinery with the Department of Marine and Fisheries. He retired from government service in 1950.

Mr. Hopper became a Member of the Engineering Institute in 1923 and attained life membership in 1953.

Personals

News of the Personal Activities

of

Members of the Institute

H. S. Short, M.E.I.C., recently retired from his position as contract engineer of the Ontario division of Dominion Bridge Company Ltd. He will continue to be associated with the company as consultant, sales and contracting.

Mr. Short has spent 50 years in the structural steel industry. He began his career as a draughtsman with the Canada Foundry Company in 1906. In 1912 he became draughtsman checker with the Hunter Structural Steel Company and then in 1915 began his long association with Dominion Bridge, progressing through the positions of draughtsman, assistant chief draughtsman, sales engineer for Northern Ontario and Quebec, and, for the past 13 years, as contract engineer.

Mr. Short is a director of the Sault Structural Steel Company and a director and past-president of the Canadian Institute of Steel Construction. He is also a member of the Association of Professional Engineers of Ontario.

H. S. Short, M.E.I.C.

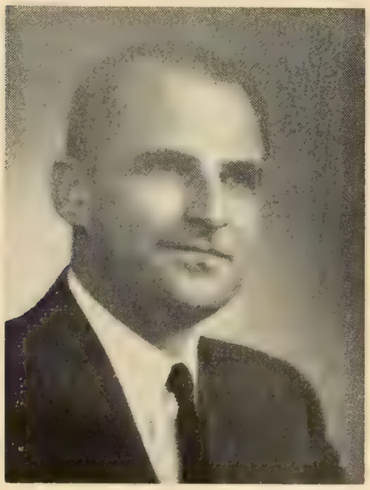
MacKenzie McMurray, M.E.I.C., has been appointed sales manager in charge of sales and contracting by Dominion Bridge Company Ltd., Ontario division. He was formerly production manager with the company.

Mr. McMurray graduated in 1939 from the University of Toronto in metallurgical engineering and spent the following year at the University as a demonstrator in mining engineering.

In 1940 he joined the staff of Dominion Bridge's Toronto branch and spent the next five years as metallurgist and chief inspector at the Sorauren Avenue plant, then engaged in the production of munitions. He occupied a number of positions in the company's Toronto and Lachine, Que., plants until 1949 when he was appointed welding engineer at Toronto, a position he held until 1953 when he became production manager at that plant.

In 1954 Mr. McMurray received the degree of master of commerce from the University of Toronto. He is a member of the Association of Professinal Engineers of Ontario, of the American Society of Metals, and of the Canadian Welding Society.

He is a member of council of the Engineering Institute, and a past-chairman of the Toronto Branch.



M. McMurray, M.E.I.C.

Hydro Officials Promoted

The City of Winnipeg Hydro Electric System announces the appointment of **R. T. Harland,** M.E.I.C.,, as chief engineer and **M. D. Young,** M.E.I.C., as assistant chief engineer. Mr. Harland succeeds **D. C. Bryden,** M.E.I.C., who is now the utility's assistant general manager.

Mr. Harland graduated from the University of Manitoba with a B.Sc. degree in electrical engineering in 1938. In 1941 he received his M.Sc. degree from the Massachusetts Institute of Technology. He joined the staff of the Winnipeg Hydro in 1941, but from 1942 until the end of the war, served with the R.C.A.F. Returning to the Hydro in 1945, he became assistant principal engineer in 1948, and in 1952, principal engineer in charge of design.

R. T. Harland, M.E.I.C.

M. D. Young, the new assistant chief engineer, graduated from the University of Manitoba in 1925 with a bachelor's degree in electrical engineering.

He joined the staff of Winnipeg Hydro in 1926 and has progressed through the positions of distribution engineer in 1930, assistant superintendent of distribution in 1938, assistant general superintendent in 1943 to general superintendent in charge of distribution in 1946.

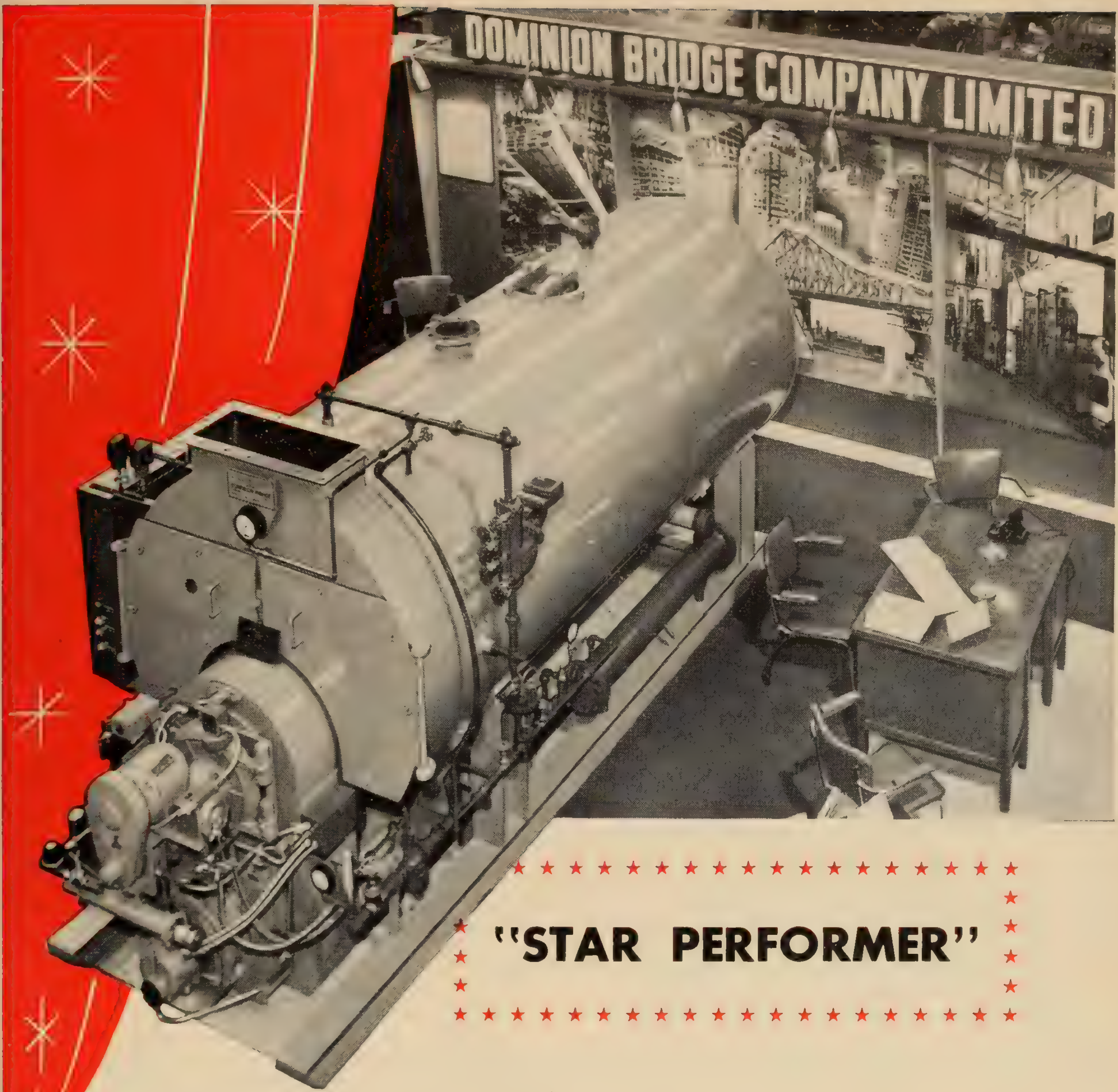
Both Mr. Young and Mr. Harland are members of the Association of Professional Engineers of Manitoba and the Manitoba Electrical Association.

M. D. Young, M.E.I.C.

William O. Horwood, M.E.I.C., is now assistant to the president of International Equipment Company Ltd. at their head office in Montreal. Mr. Horwood was formerly branch manager of Lyman Tube and Bearings Ltd. in Toronto.

A mechanical engineering graduate of McGill University, class of 1937, he had joined Lyman Tube and Bearings Ltd. in 1945 and has also been eastern sales manager of that company's tubing and railway division.

J. H. Smith, M.E.I.C., vice-president and general manager of Canadian General Electric Company Ltd., who was recent-



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ly transferred to Montreal to head the company's appliance division, is now in Peterborough, Ont., where he will hold the corresponding position in the apparatus division.

James Lundie, M.E.I.C., has been appointed district engineer of the Canadian Pacific Railway's New Brunswick district, with headquarters in Saint John. For the past two years Mr. Lundie has been locating engineer for the C.P.R. at Hemlo, Ont., where he built the recently opened Manitouwadge sub-division.

Mr. Lundie has been with the C.P.R. since his graduation in civil engineering from the University of Saskatchewan in 1930.

In 1939 he was appointed bridge and building master at Regina, and from 1944 to 1950 served as division engineer at Schreiber, Ont., Woodstock, Ont., and London, Ont. He was then appointed assistant district engineer at Toronto, a post he held until taking on the Manitouwadge project.

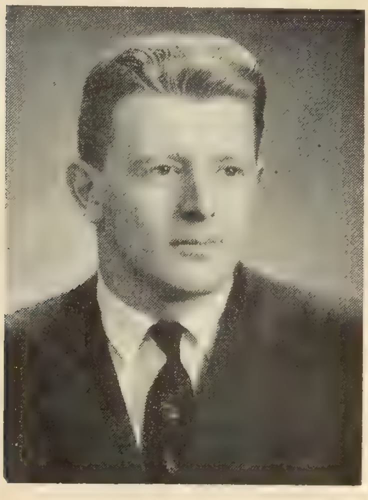
D. L. Dickson, M.E.I.C., has been named vice-president of the Eastern Electrical Supply Company in Montreal. He joined the company earlier this year as sales engineer.

A graduate of the College of Technology in Belfast, Mr. Dickson has also been electrical assistant with the Electric Tamper & Equipment Company in Montreal.

D. C. MacCallum, M.E.I.C., president of Racey, MacCallum and Associates Ltd., announces the appointment of **George L. Houghton,** M.E.I.C., as executive engineer in charge of the Toronto division of the company, and **R. Murray Campbell,** M.E.I.C., as executive engineer in charge of the Montreal division.

Mr. Houghton was previously assistant to the vice-president, Toronto division and Mr. Campbell was previously assistant to the president (technical).

Lionel Swift, M.E.I.C., has been appointed assistant general manager for Canadian Hoosier Engineering Company Ltd. in Montreal.



G. L. Houghton, M.E.I.C.

Lionel Swift, M.E.I.C.

Mr. Swift is a native of Shawinigan Falls, Que., where he received his early schooling and where he worked for some years before starting his studies at McGill University. He graduated in electrical engineering in 1934 and then spent the following two years on the Shawinigan Water and Power Company's training course. He worked in the generating and transmission department until 1945 when he was transferred to the Quebec Power Company.

With Quebec Power he successively occupied the positions of superintendent of the engineering department, superintendent of the electricity division, and finally, general superintendent of operations.

He is a member of the Corporation of Professional Engineers of Quebec, and of the American Institute of Electrical Engineers. He was also assistant professor in the electrical department of Laval University.

F. M. Kraus, M.E.I.C., has now established his own consulting engineering business in Montreal. He was previously with the Stadler Hurter Company in Montreal as structural design engineer.

Mr. Kraus received his doctor of engineering degree from Politecnico Di Turin in Italy in 1947.

R. M. Campbell, M.E.I.C.

W. A. Bentley, M.E.I.C.

William A. Bentley, M.E.I.C., has been named contract engineer for the Ontario division of Dominion Bridge Company Ltd.

Mr. Bentley received his education at Central Technical School and the University of Toronto. He spent a year with the Solway Process Company in Syracuse, N.Y., and then returned to Toronto in 1927 to join the staff of the McGregor-McIntyre Iron Works. After that company was taken over by Dominion Bridge in 1928 he served in various capacities until 1941 when he was appointed resident engineer of the Sorauren Avenue munitions plant. From 1946 he has been sales engineer in charge of mining sales, and in 1951 and 1952 he was on loan to the steel division of the Department of Defence as chief of the fabricating section.

Lt. Col. J. L. Dery, M.E.I.C., has joined Franki Compressed Pile Company of Canada Ltd. and will take charge of the new branch office to be opened in Ottawa. He was formerly with Pentagon Construction Ltd. in Montreal.

A graduate of the Royal Military College of Canada in 1934, Mr. Dery was in the Montreal district office of the Department of Public Works of Canada from 1934 to 1946. He served overseas during the Second World War with the R.C.A.

He has also been associated with Labrador Construction Ltd. and with Key Construction Limited in Montreal prior to joining Pentagon Construction in 1952.

Dr. W. C. Gussow, M.E.I.C., was recently honoured by the American Association of Petroleum Geologists. He was named distinguished lecturer and spent the month of November travelling extensively through the United States lecturing on "Problems of Oil Migration". While in Los Angeles he was the keynote speaker of the Association's annual regional meeting.

Dr. Gussow who practices as a consulting geologist in Calgary Alta. has travelled and worked in 18 different countries. He holds his B.Sc. and M.Sc. degrees from Queen's University in geology and mineralogy and before entering private practice was employed as chief geologist for the Shell Oil Company of Canada.

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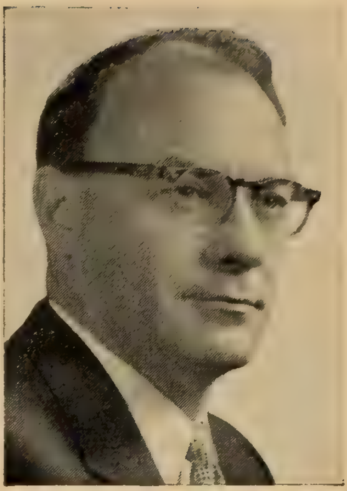
• *Personals*

R. N. Fournier, M.E.I.C., has been named manager of the mid-west district of the wholesale department of Canadian General Electric Company Ltd. in Winnipeg, Man.

A graduate in engineering physics from the University of Saskatchewan, Mr. Fournier joined C.G.E. in 1937. He served during the Second World War with the R.C.N.V.R. and returned to C.G.E. in 1945 as manager of the supply division in Halifax, N.S. Since 1952 he has been manager of the Maritime district of the wholesale department with headquarters also in Halifax.



R. N. Fournier, M.E.I.C.

J. G. Malus, M.E.I.C., has taken a position as structural engineer with H. A. Simon Limited, consulting engineer, in Vancouver, B.C.

Mr. Malus was formerly in Regina, Sask., with the Canadian Pacific Railway. He graduated in 1952 from the University of Manitoba in civil engineering and joined the C.P.R. as transitman in the division engineer's office.

Wm. A. Arsenault, M.E.I.C., is now associated with Fraser-Brace Engineering Company Ltd. in Montreal.

Mr. Arsenault was previously employed as resident engineer with the Rankin Newfoundland Company at St. Lawrence, Nfld.

A graduate of Nova Scotia Technical College in 1937, he has also been resident engineer with the Nova Scotia Department of Highways at Amherst, N.S.

D. R. C. Morris, M.E.I.C., has been transferred to Beauharnois, Que., by the Aluminum Company of Canada. His position will be superintendent of the mechanical and electrical division. He was previously in Shawinigan Falls, Que., for the company as electrical superintendent of their plant there.

Mr. Morris graduated from McGill University in 1947 in electrical engineering.

W. G. Enouy, M.E.I.C., has been appointed manager of the new Ottawa district sales office of Robertson-Irwin Ltd. of Hamilton, Ont. He was formerly manager of the Montreal branch of the company.

Mr. Enouy graduated in 1927 from the University of Toronto and immediately joined the H. H. Robertson Company in Toronto. He was transferred in 1936 to Montreal as district manager and then recalled to Toronto in 1946, moving to Hamilton with the transfer of the company headquarters to that city. With the amalgamation

W. G. Enouy, M.E.I.C.

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of H. H. Robertson Company and Thomas Irwin & Son Limited as Robertson-Irwin Limited, Mr. Enouy assumed the duties of sales manager of the Robertson division, becoming subsequently general sales manager of promotion and development.

W. A. Ker, M.E.I.C., has been transferred to Victoria, B.C., by the Department of Lands and Forests, his new position is that of deputy comptroller of water rights and chief of the operations division. Mr. Ker was previously in Kelowna, B.C., with the Water Rights Branch of the British Columbia Government.

Mr. Ker is a civil engineering graduate of the University of British Columbia.

H. H. Todgham, M.E.I.C., and **C. W. Case,** JR.E.I.C., have formed a partnership as consulting civil engineers in Chatham, Ont. This new firm will offer consulting services in land surveying, drainage, structural design, and general municipal engineering.

H. H. Todgham, M.E.I.C.

C. W. Case, Jr. E.I.C.

Mr. Todgham was formerly a partner in the firm of Brisco and Todgham, Chatham, Ont., and has been in consulting practice with C. G. R. Armstrong in Windsor, Ont. He graduated from the University of Toronto in 1946 with a B.A.Sc. degree in civil engineering.

Mr. Case was deputy city engineer for the City of Chatham, having been appointed assistant city engineer after his graduation in 1950 from the University of Toronto.

C. H. Vatcher, M.E.I.C., has joined Salem Engineering Limited in Toronto as a sales engineer. Prior to this new position he was with Dominion Cutout Company Ltd. and Dominion Carbon Brush Company Ltd., also in Toronto.

A 1939 graduate of the University of Toronto, Mr. Vatcher has been with Canadian National Carbon Company Ltd., both in Vancouver and Toronto, and with the Toronto office of English Electric Company of Canada Ltd.

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• Personals

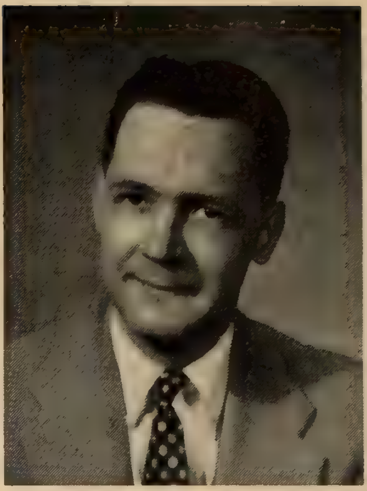
served with the engineering branch of the R.C.N.V.R.

Donald C. Rotherham, M.E.I.C., has joined S.W. Explorations, C.M.&S. Company, in Trail, B.C.

A graduate in geology from the University of Saskatchewan, Mr. Rotherham was previously associated with Dee Explorations Limited in Saskatoon, Sask., as a geologist.

A. C. Findlay, M.E.I.C., is now with the engineering department of the head office of the Dupont Company of Canada in Montreal, and is engaged in project work for the company. Previously he was with Standard Brands Limited in Montreal as plant engineer.

Mr. Findlay graduated in mechanical engineering from McGill University in 1942. After a year with Steel Company of Canada Ltd., he joined the R.C.A.F. and served for two years as a flying officer. Upon his release from the service he became associated with Canadian Vickers Limited in Montreal, and then joined Standard Brands Limited in 1947 as project engineer.



A. J. Lewis, M.E.I.C.

A. J. Lewis, M.E.I.C., was recently appointed sales application engineer of the Scintilla Division of the Bendix Aviation Corporation, Toronto, and will assist Canadian airframe and related equipment manufacturers with electrical connector requirements and applications.

Brigadier D. A. G. Waldock, M.E.I.C., has been named chief superintendent of the Canadian Armament Research and Development Establishment at Valcartier, Que. He was previously director of Army Development at Army Headquarters in Ottawa.

Brigadier Waldock enlisted in the Royal Corps of Signals in 1939, was commissioned in 1940 and attained the rank of lieutenant-colonel in 1945. He was commissioned in the Royal Canadian Artillery in 1946 as a major and in 1952 he was promoted to the rank of colonel as commanding officer at Valcartier.

Early in 1955 he was named director of Armament Development at Army Headquarters, and in November was transferred to the Defence Research Board as chief superintendent.

Colonel C. R. Boehm, M.E.I.C., will relinquish command of Canadian Armament Development and Experimental Establishment and his appointment as deputy chief superintendent of the Canadian Armament Research and Development Establishment on being transferred to Defence Research Board headquarters as director of liaison. Col. Boehm will coordinate scientific liaison between D.R.B. headquarters and the defence research members on the Canadian Joint staffs in London and Washington.

A 1929 graduate of the University of Toronto, Col. Boehm was employed prior to the war as mining engineer in northern Ontario and Quebec. He was commissioned in the R.C.O.C. at the beginning of the war, transferring to the R.C.E.M.E. upon its formation. He served overseas with both corps for over five years.

In April, 1946 Colonel Boehm was promoted to his present rank and became deputy director of mechanical engineering at Army Headquarters, subsequently becoming director in 1948. Five years later he was appointed to London, England, as deputy Army member, Canadian Joint Staff, after

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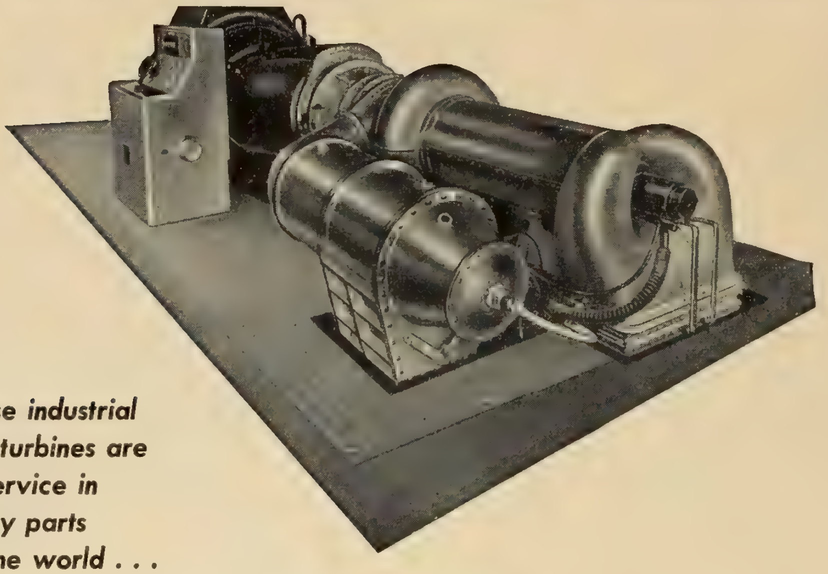

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• *Personals*

attending the National Defence College at Kingston, Ont.

Early in 1955 he was named deputy chief superintendent of the Canadian Armament Research and Development Establishment at Valcartier, Que., and at the same time he was commanding officer of the Canadian Armament Design and Experimental Establishment, the Army unit integrated with the Defence Research Board research station at Valcartier.

J. S. Busby, JR.E.I.C., assistant division engineer of the Cochrane division of the Canadian National Railways, is the new secretary-treasurer of the North Eastern Ontario Branch of the Engineering Institute.

Mr. Busby served with the R.C.N.V.R. during the Second World War and then received his civil engineering degree from the University of New Brunswick in 1948.

That year he joined the Montreal Engineering Company as assistant purchasing agent, and then in 1950 first became associated with the C.N.R. as instrumentman in the Laurentian division. In 1952 Mr. Busby was junior assistant engineer in the Cochrane division and then assistant engineer in 1953 in the same division. He was appointed assistant division engineer in June, 1955.

He is a member of the Corporation of Professional Engineers of Quebec.

Mr. Busby joined the Engineering Institute as a Student in 1946, transferring to Junior in 1950.

Claude Senneville, JR.E.I.C., is now with the firm of Deschamps and Belanger, engineers and contractors of Montreal. He has recently returned from Europe where he was with Defence Construction (1951) Limited as area engineer in eastern France.

Mr. Senneville is a 1947 graduate of Ecole Polytechnique in civil engineering.

Christian R. deLannoy, JR.E.I.C., has been transferred by the Aluminum Company of Canada to Kitimat, B.C. He was previously in Isle Maligne, Que., as trainee with the company.

Mr. deLannoy received his B.Sc. degree from the Catholic University of Louvain in 1947, and his M.Sc. degree in 1950.

Kenneth H. Cram, JR.E.I.C., was recently appointed an assistant professor in the chemical engineering department of the University of Kansas. He was formerly with the chemical and metallurgical division of General Electric in Pittsfield, Mass.

Mr. Cram graduated in 1947 from McGill University with a bachelor's degree in chemical engineering and then spent three years with the Aluminum Company in Arvida, Que. Then he entered the graduate school at Princeton University and obtained a Ph.D. degree in chemical engineering.

Harvey N. Burrows, JR.E.I.C., has been transferred by Canada Cement Company Ltd. to Fort Whyte, Man., as plant engineer. He previously held the same position in Montreal East, Que., for the company, and has also been plant engineer at the company's Port Colborne, Ont., plant.

Mr. Burrows graduated in 1947 from the University of Saskatchewan with a B.Eng. degree in ceramics, and has also been employed by Canadian Gypsum Company Ltd. at Hagersville, Ont.

Captain D. C. H. Francis, JR.E.I.C., has been posted to the School of Military Engineering of the British Army as an Exchange instructor at Chatham, Kent, England.

Captain Francis graduated in 1949 from the University of Saskatchewan with a B.Sc. degree in civil engineering. He joined the R.C.E. upon graduation and was stationed at the R.C.S. M.E., Chilliwack, B.C.

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W. F. Allen, JR.E.I.C., is now project engineer with the Consolidated Toronto Development Corporation. He was formerly in Windsor, Ont., as a design engineer with the Ford Motor Company of Canada.

Mr. Allen is a 1949 graduate of Cambridge University in mechanical engineering, and has also been with the Department of Highways at Hamilton, Ont., as estimating engineer.

John T. Sinclair, JR.E.I.C., has been transferred to Toronto from Sarnia, Ont., by Imperial Oil Limited.

Mr. Sinclair graduated in 1949 from the University of Toronto with a B.A.Sc. degree in chemical engineering.

A. D. R. Robertson, JR.E.I.C., is with the Water Rights Branch of the Department of Lands and Forests of the British Columbia Government at Victoria, B.C., as hydraulic engineer.

A 1949 civil engineering graduate of the University of British Columbia, Mr. Robertson has also been connected with British Columbia Forest Service as project engineer, and with B.C. International Engineering Company Ltd. as design engineer in Vancouver.

Donald W. Gordon, JR.E.I.C., is now with the Bridge and Tank Company in Hamilton, Ont. He was formerly connected with Vulcan Iron Works Ltd. in Winnipeg, Man.

Mr. Gordon, who graduated in 1950 from the University of British Columbia in mechanical engineering, has also been with the tank department of the Toronto Iron Works.

William M. Kruse, JR.E.I.C., is now employed as a zone engineer with the mechanical department of Imperial Oil Limited at their Sarnia, Ont. refinery. He was field engineer with the Steel Company of Canada in Hamilton, Ont.

Mr. Kruse received his B.A.Sc. degree in civil engineering from the University of Toronto in 1950.

J. D. Dunn, JR.E.I.C., has joined Canadian Splint and Lumber Corporation, Ltd., as plant engineer in Pembroke, Ont. He was previously plant engineer at Nobel, Ont. for A. V. Roe of Canada Ltd.

Mr. Dunn graduated from Nova Scotia Technical College in 1951 with a

SUB-SURFACE EXPLORATION
Soil Sampling • Foundation Testing
Core Drilling • Grouting

FOR EXAMPLE:
HYDRO PROJECTS
Job 54-107
Ladore Falls Powerhouse
B. C. Power Commission
Construction is now underway on the hydroelectric plant at Ladore Falls near Campbell River on Vancouver Island. On completion of the project a further 105,000 h.p. will be added to the power available for west coast industries at a total cost of $9,700,000.
Boyles Bros.' crews have completed the extensive foundation testing program for this major development during the past year.

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BOYLES BROS
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Modern Equipment and Experienced Crews
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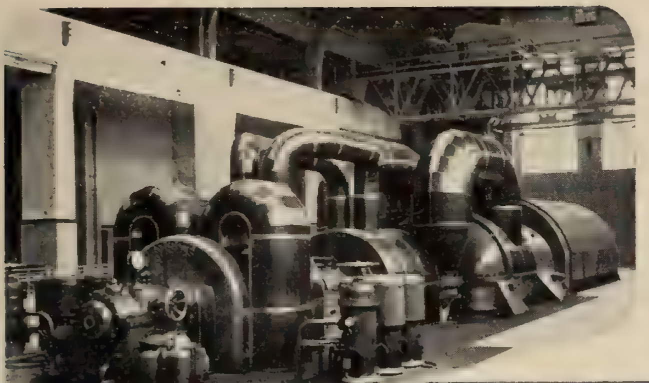
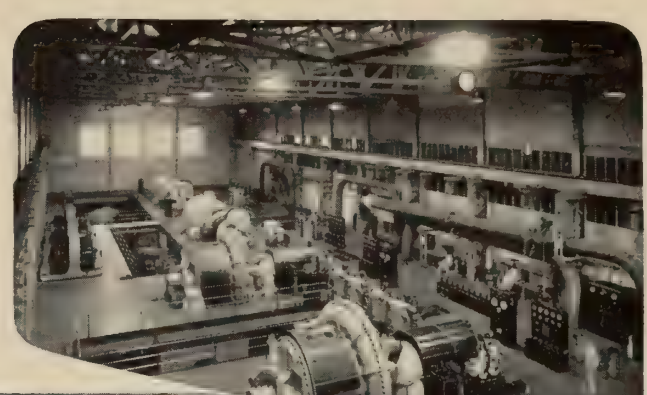
TURBO-GENERATORS • TURBO-BLOWERS

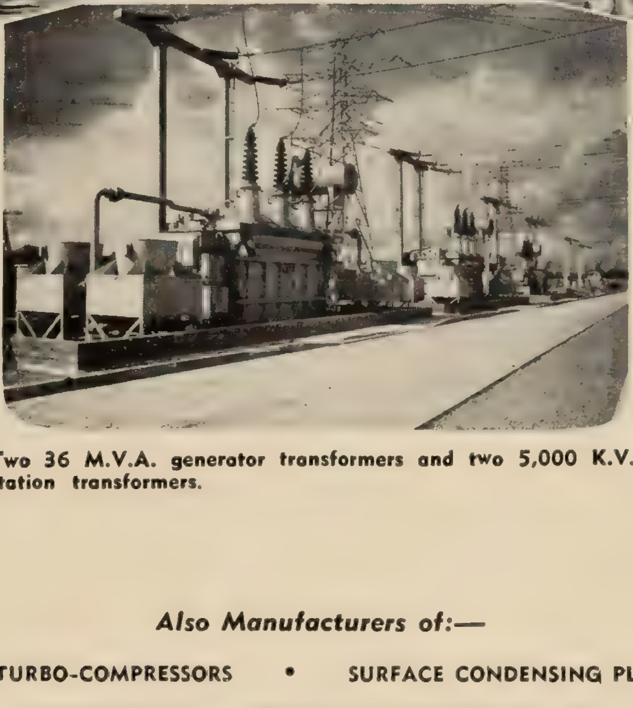
TRANSFORMERS



60 M.W. Turbo-generator installed in a British power station.



Four turbo-blowers (duty of each blower 80,000 cubic feet of free air per minute delivered at 30 lbs. per square inch pressure.)



Two 36 M.V.A. generator transformers and two 5,000 K.V.A. station transformers.

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• Personals

bachelor's degree in mechanical engineering.

Douglas R. Wilson, Jr.E.I.C., has been appointed town engineer of Georgetown, Ont. He formerly held the same position at Greenfield Park, Que.

A civil engineering graduate of McGill University, class of 1951, Mr. Wilson spent some time on the divisional staff of Canadian National Railways and then joined H. W. Lea, consulting engineer of Montreal for two years.

In 1953 he was associated with Shell Oil of Canada as construction engineer with their Montreal East refinery and then in 1954 became town engineer of Greenfield Park.

Mr. Wilson served during the Second World War with the R.C.N.

Jean Louis Desautels, Jr.E.I.C., is presently employed as resident engineer with Defense Construction (1951) Limited, stationed at No. 2 (F) Wing, R.C.A.F., in Grostenquin (Moselle), France.

Mr. Desautels graduated with honours from the University of Toronto in 1951 with a B.A.Sc. degree in mechanical engineering, and has been with the Canadian International Paper Company at Three Rivers, Que.

W. E. Erlebach, Jr.E.I.C., has returned to Canada after receiving his Ph.D. degree at Cambridge University on an Athlone Fellowship, and is employed as an assistant research officer by Atomic Energy of Canada Ltd. at Chalk River, Ont.

Mr. Erlebach graduated from the University of British Columbia in chemical engineering receiving his B.A.Sc. degree in 1951 and his M.A.Sc. degree in 1953.

W. H. Loney, Jr.E.I.C., has been named plant engineer with Hobart Manufacturing Company Ltd. in Owen Sound, Ont. He was previously production engineer for the company.

Mr. Loney graduated in 1951 from the University of Toronto in mechanical engineering.

H. B. McLenaghan, Jr.E.I.C., is now in Fort Garry, Man., with Malcom Construction of Winnipeg, employed as an estimator. He was formerly with Structural Engineering Services in Calgary, Alta. as a structural engineer.

Mr. McLenaghan graduated in 1952 in civil engineering from the University of Manitoba, and has also been associated with J. A. Lamb, consulting engineer in Calgary, and with the Central Mortgage and Housing Corporation as assistant resident engineer, also in Calgary.

R. Bryan Erb, Jr.E.I.C., has returned from a two year post-graduate course in England studying aerodynamics, and is now with Avro Aircraft Limited at Malton, Ont., as an aerodynamicist.

Mr. Erb graduated in 1952 from the University of Alberta in civil engineering.

Grant M. Locke, Jr.E.I.C., is now employed as design engineer in the atomic division of the Canadian General Electric Company in Peterborough, Ont.

Mr. Locke graduated from the University of New Brunswick in 1952 in civil engineering, and has recently been in Pittsburgh, Penn., with the Pittsburgh Des Moines Steel Company.

Jean Favron, Jr.E.I.C., is now with the aircraft design department of Canadair Limited, Montreal, as a designer. He recently returned from England, where he spent two years on an Athlone Fellowship.

He graduated in 1952 from Ecole Polytechnique with a B.A.Sc. degree in mechanical and electrical engineering, and then was employed as a mechanical design engineer with Canadian Industries Limited in Brownsburg, Que.

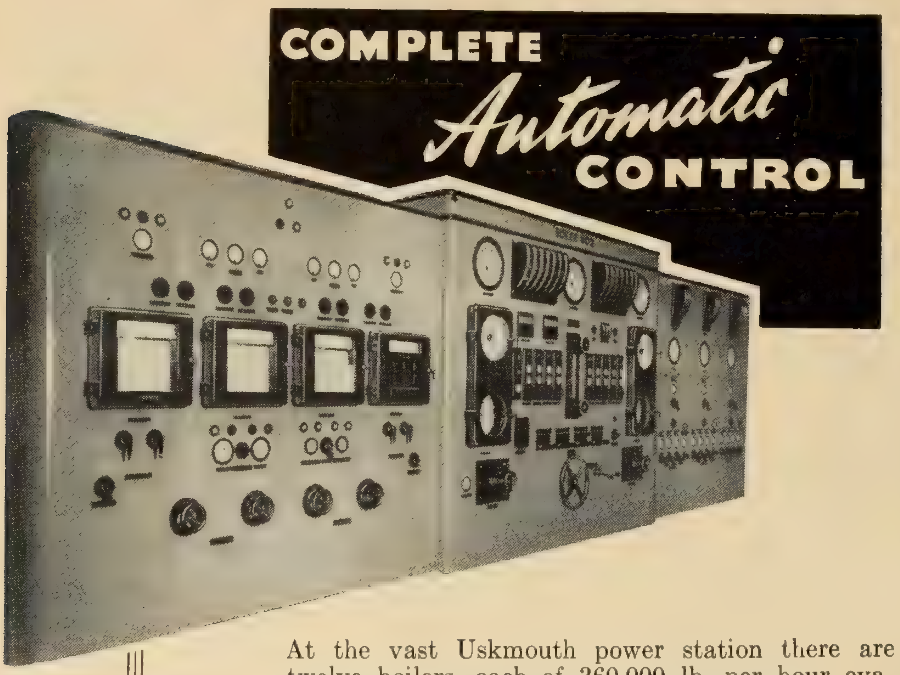
William M. Chisholm, Jr.E.I.C., is now on the staff of the Ottawa Hydro-Electric Commission as junior distribution engineer.

A 1952 graduate of Nova Scotia Technical College in electrical engineering, Mr. Chisholm has previously been with the International Nickel Company of Canada at Copper Cliff, Ont., and at Levack Mine.

Robert A. Newey, JrE.I.C., has now joined the staff of Dominion Engineering Company Ltd. in Montreal.

Mr. Newey is a mechanical engineering graduate of the University of Manitoba, class of 1953.

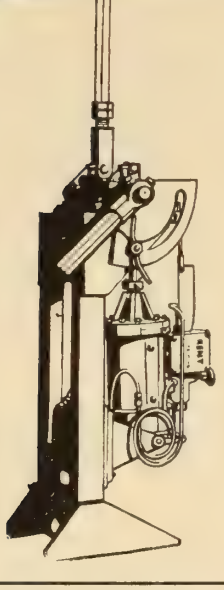
He has been in England, where he was an engineering student apprentice with C. A. Parsons & Company Ltd., in Newcastle on Tyne.



At the vast Uskmouth power station there are twelve boilers, each of 360,000 lb. per hour evaporative capacity, and each has its own instrument panel, as illustrated, for automatic control of its complete operation. In a central control room, master instruments permit the control of boilers in sets of four, or singly.

The whole automatic control scheme is pneumatically operated and based on the KENT Mark 20 system.

An outstanding and unusual feature is the use of the new KENT Oxygen Recorder for flue-gas analysis. Measurement of flue-gas oxygen, linked through the Mark 20 Controller to automatic adjustment of air input, results in new efficiency in fuel consumption. The scheme also incorporates the very latest method developed by KENT Research Staff, of automatic control of superheated steam temperature.



One of the KENT Mark IV power cylinders operating primary-air dampers.

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- ✶ *How fast* can the building be completed?
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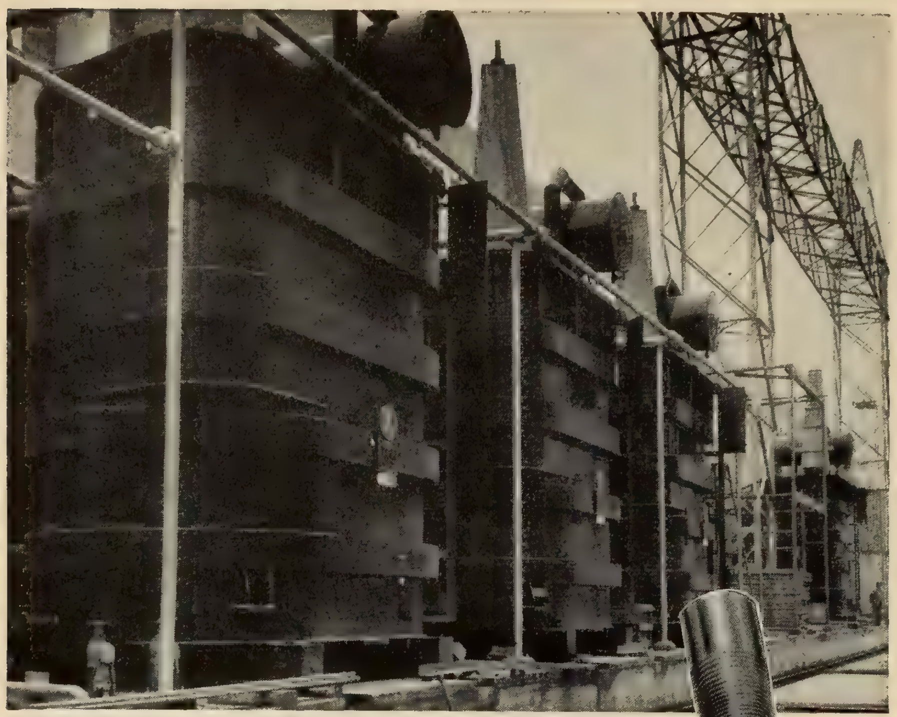
9 out of 19 Transformers and all 12 Generators are cooled by "UNIFIN"* . . .



. . AT SIR ADAM BECK NIAGARA GENERATING STATION NO. 2

Shell and tube heat exchangers, employing Unifin Type S/T (Lo-Fin) Tubing, are installed on 9 of the 19 transformers at this station. More compact, more efficient, less costly cooling equipment is the result. A Design Manual demonstrating the superior efficiency and economy of Unifin Type S/T Tubing is available on request.

Cooling equipment for all 12 of the hydro-electric generators is also supplied by Unifin . . . partly in the form of complete heavy duty cooling coils, and partly in the form of finned tubing for fabrication into coolers. Unifin all-copper Hi-Fin coils are also used in the oil-bath cooling of bearings.

For *your* heat transfer problems, too, Unifin tubing can offer substantial advantages over other types. Write for engineering data and samples to:

Unifin Tube Company LONDON, CANADA

* The only integral finned tube Patented in Canada and patents pending.

• Personals

J. Glenn Allan, Jr.E.I.C., is now with Canadian National Railways, and is employed as junior assistant engineer in the Belleville division office, Belleville, Ont.

Mr. Allan graduated in 1953 from Queen's University in civil engineering and then joined the Department of Highways of Ontario in Toronto.

Sydney Narvey, S.E.I.C., has been named senior engineer with Canadian Kodak Company Ltd., working on the design and installation of the plant air conditioning systems. He was formerly chief engineer with Engineering Industries Company Ltd. in Toronto.

Mr. Narvey graduated from North Carolina State College in 1953 with a B.Sc. degree, and spent some time as sales engineer with the refrigeration and air conditioning division of John Inglis Company Ltd. in Vancouver, B.C.

Zoltan D. Simo, S.E.I.C., is now employed as mechanical superintendent with Canada Packers at Edmonton, Alta. He graduated last year from the University of Saskatchewan with a B.Sc. degree in mechanical engineering.

Raymond Dumas, S.E.I.C., who graduated last year from Laval University with a B.A.Sc. degree in civil engineering and has recently been in Munich, Germany, studying prestressed concrete, is now in Labrieville, Que., with Concrete Repairs and Waterproofing Company Ltd.

F. R. Scrase, S.E.I.C., has been transferred by Canadian National Railways from Belleville, Ont., to Stratford, Ont., working in the division engineer's office. He graduated this year from the University of Manitoba with a B.Sc. degree in civil engineering.

Myron Flett, S.E.I.C., who graduated this year from Nova Scotia Technical College with a bachelor's degree in mechanical engineering, is now working with the firm of R. M. Way & Company Ltd., consulting engineers in Toronto.

Leonard R. Walker, S.E.I.C., is now an engineering trainee at Canadair Limited in Montreal. He is a 1955 graduate of the University of Manitoba in mechanical engineering.

F. D. McIntosh, S.E.I.C., has joined the Department of National Defence, armaments branch in Ottawa, Ont., as methods engineer for inspecting services. He received his B.A.Sc. degree this year from the University of Toronto in engineering and business.

William Brownlee, S.E.I.C., who graduated this fall from McGill University with a bachelor's degree in mechanical engineering, is now working with Rolls-Royce Limited in Montreal.

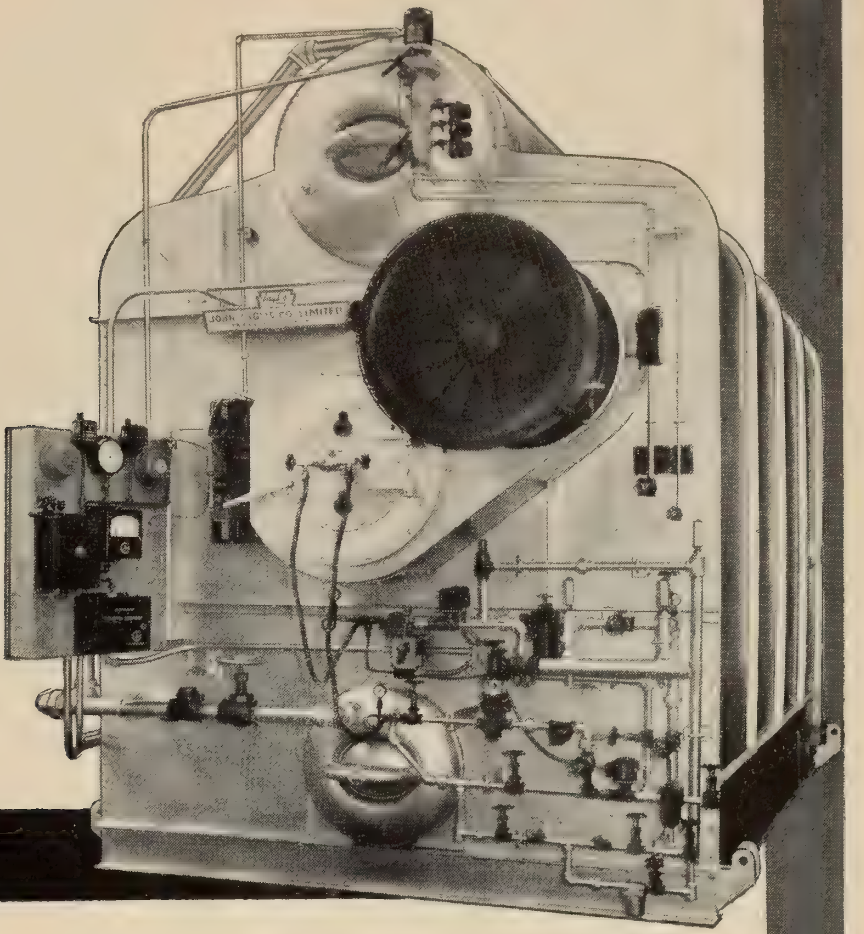
A. H. Abbott, S.E.I.C., has joined the Department of Highways and Public Works of Nova Scotia as a structural engineer in Halifax, N.S.

Mr. Abbott graduated from the University of New Brunswick this year in civil engineering.

M. M. Krpan, S.E.I.C., an electrical engineering graduate of the University of Alberta, class of 1955, is now employed by the Hydro-Electric Power Commission of Ontario in Toronto.

Package with a punch!

Inglis
CANADA



Dependable, high capacity water tube service in a compact, packaged unit . . . that's what you get with this Inglis-Erie type K steam generator. Burner, controls and instrument panel are an integral part of the unit. And all of it is shop tested before shipment. An ideal boiler for oilfield use, 200 p.s.i.g. units are now going into service at the Fort William Refinery of Husky Oil and Refining Ltd. (33,200 lbs. per hour); Excelsior Refineries Ltd., at Lloydminster (11,610 lbs. per hour), and X-L Refineries Ltd. at Dawson Creek (two units, 16,620 lbs. per hour each). Inglis will gladly give you all the facts about this convenient, easy-to-install unit.

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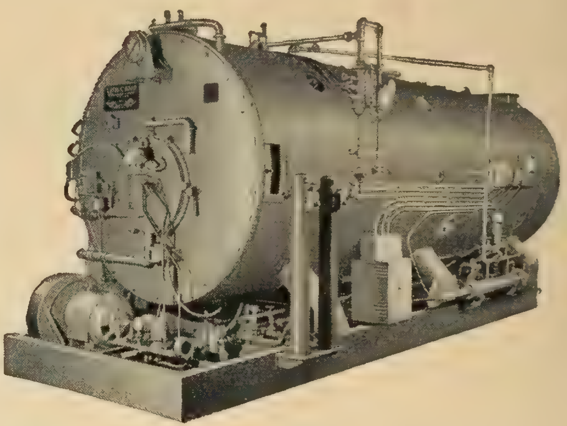

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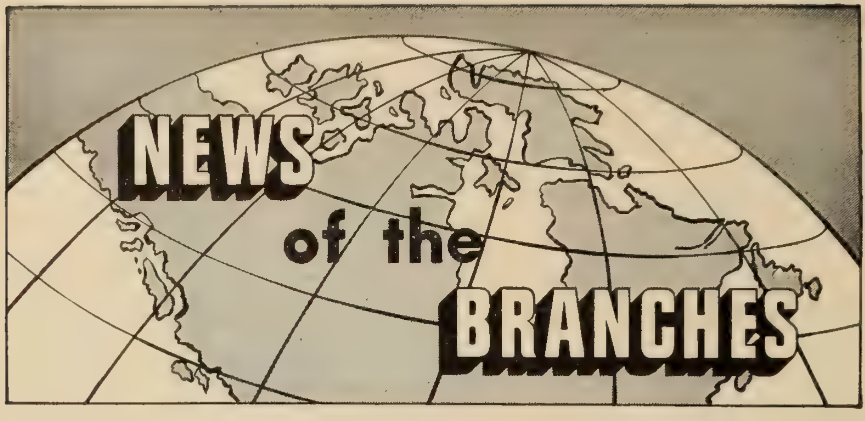

Activities of the Forty-seven Branches of the Institute

and

abstracts of papers presented at their meetings

Belleville

J. A. Grant, M.E.I.C.,
Secretary-Treasurer

General Meeting

The Belleville Branch of the Engineering Institute of Canada held its second meeting of the 1955-56 season on November 14, 1955, at the Masonic Temple. Approximately 20 members and guests attended.

C. L. Curry, assistant chief supervisor of field maintenance at the Maitland Works of Dupont of Canada spoke on "Instrumentation in a Continuous Process Plant". His talk was illustrated by lantern slides and was found very instructive to his audience.

The speaker was introduced by B. H. Downman and thanked by C. E. Meyers.

Brockville

K. R. Bullock, Jr.E.I.C.,
Secretary-Treasurer

G. M. Woods, M.E.I.C.,
Branch News Editor

Engineers and Guests Tour R.C.A. Victor Plant

The Brockville Branch members and their families, approximately 75 people, spent an informative morning on October 15 visiting the R.C.A. Victor Co. Ltd. in Prescott, Ont.

The tour was conducted through the five major production lines, each 350 ft. long, by the R.C.A. staff members.

The visitors were shown the printed circuit which is a special feature or advancement this year. The production of printed circuits are subassembled on their own sections and then moved to the main assembly line where they are added to the main chassis.

W. V. Heyden on behalf of A. M. Patience, plant manager, welcomed the visitors in the cafeteria, giving them some interesting statistics.

1000 T.V. Sets a Day

Other factors or production figures of Canada's biggest radio and television factory can be visualized by considering the enormous scheduling and planning problems.

Approximately 20 tubes for each 1,000 sets means 20,000 tubes per day; 300 electrical and 200 mechanical components per set, equals 500,000 components a day; for every five workers, there are two inspectors to check for the quality of the product.

Each component is already counted and tested some way or other before it enters the factory. This close inspection and quality control follows the sets on their route through the whole production cycle until they are shipped.

Chairman Fred Walsh, on behalf of the members and their families, thanked the R.C.A. Victor people for their conducted tour and the lunch.

Principles of Investment

R. D. Steers, educated at Loyola College and an associate of the R. D. Steers investment firm, was speaker at the Junior Member meeting held at the Manitonna Hotel on November 3.

Mr. Steers subject was "Principles of Investment".

The speaker stressed the point that "one should consider stocks as a part of his investment program, as part of his planning for the future as a means of putting his surplus funds to work, but not as a detour into gambling." He continued by saying that "the investor should realize that there is no royal road to riches, but that one should expect a reasonable income on his money plus a slow steady growth in values."

One of the best investments, Mr. Steers stated is Canada Savings Bonds. They are negotiable and have an attractive interest rate.

The speaker was introduced by W Simmons and thanked by T. Reade.

Eastern Townships

J.-P. Champagne, Jr.E.I.C.,
Secretary-Treasurer

G. Lorne Wiggs Is Guest Speaker

The eastern Townships Branch held a joint meeting with the Corporation of Professional Engineers of the Province of Quebec on Friday, November 11. G. Lorne Wiggs, Corporation president, was the guest speaker.

Mr. Wiggs said he was very happy to be in Sherbrooke in that he counts himself a resident since he spends his summers near one of Sherbrooke's "suburbs" — Magog. The Corporation has had a successful year, he said, in that it has brought its total membership up to 5,300, and has seen the completion of its new Montreal headquarters.

Corporation's Work Is Described

The demand for qualified engineers is still increasing, he said, as can be seen by the metropolitan newspaper ads for engineers to serve in Ottawa, Hamilton, Vancouver, Cleveland, etc. He admitted that the Quebec engineer does not quite, as yet, partake of the same privileges as engineers of other provinces; his role in the planning of a public building is second to that of the architect. However, the Corporation is working hard to enhance the prestige of the profession, he said, by keeping a strict surveillance over the use of the title of engineer; by insisting that public bodies hire engineers rather than other professionals when, due to the nature of the work, it can be performed as well, or better, by an engineer. Mr. Wiggs pointed out that more and more Quebec firms are employing engineers directly to design the electrical, mechanical and structural works of their projects rather than em-

Honorary Chairmen G. M. Dick (left) and A. C. Crépeau (right) of the Eastern Townships Branch welcome G. Lorne Wiggs (centre) president of the Corporation of Professional Engineers of Quebec and guest speaker on November 11.

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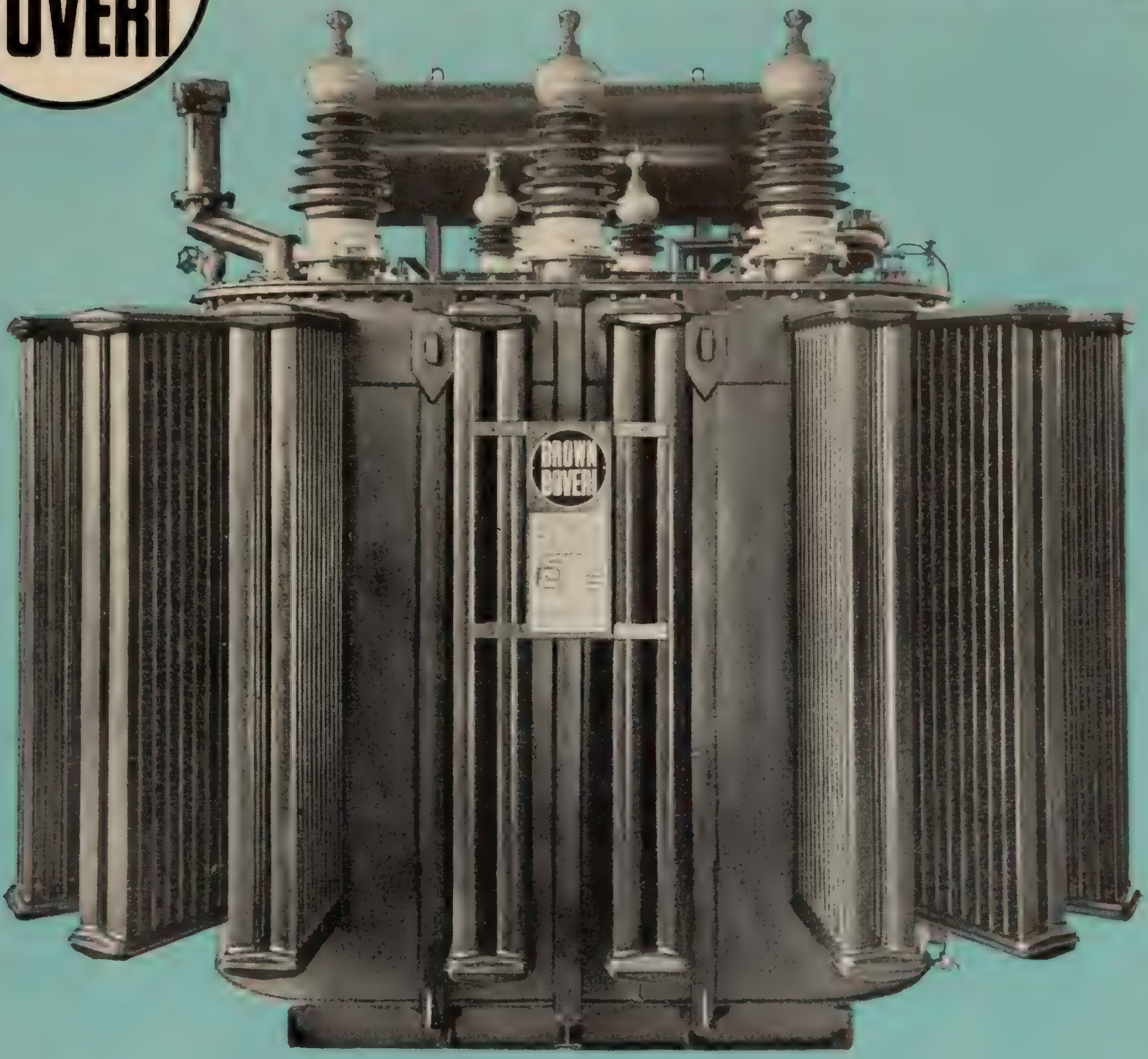
serving Canadian industry...



TRANSFORMERS

Brown Boveri Transformers in standard three phase ratings up to 12,000-kva and voltages up to 115-kv are rolling steadily from our St. Johns, Que. plant. They are designed and manufactured *specifically* to meet power requirements of Canadian industry.

Brown Boveri Transformers are highly efficient. They weigh less . . . use less oil – require less floor space. Other *exclusive* design and constructional features add to this efficiency . . . save you capital dollars—operational dollars.

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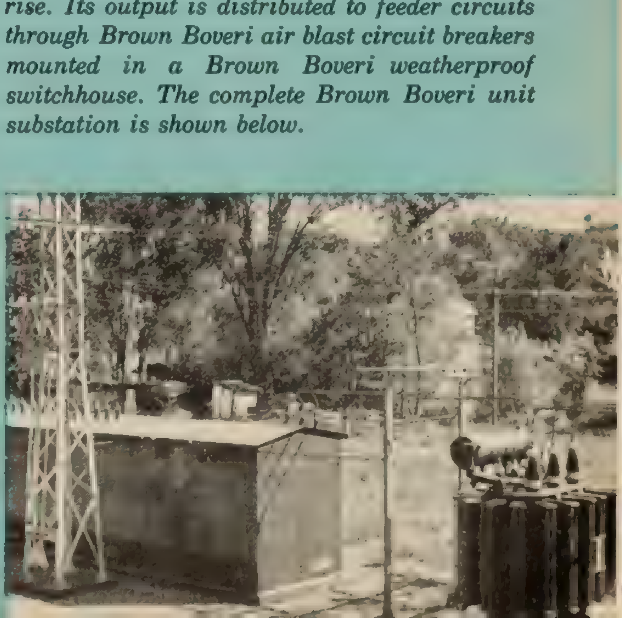
The Brown Boveri Transformer illustrated above has the following characteristics, Type ONS 3000-kva, 48,000 H.V. Delta, 13,860 L. V. Star, 3 phase, 60 cycle, 55°C Temperature rise. Its output is distributed to feeder circuits through Brown Boveri air blast circuit breakers mounted in a Brown Boveri weatherproof switchhouse. The complete Brown Boveri unit substation is shown below.



ploying them indirectly through architects. A number of others, he said, are employing engineers as project managers to direct and control both architects and consulting engineers who prepare the plans and specifications for their projects.

Executive Changes

During the meeting two important changes in the executive of the local groups were announced. Jacques Lemieux was appointed chairman of the Eastern Townships Branch of the Engineering Institute to succeed Walter Sutherland who had resigned this office because of his frequent absence from Sherbrooke. Gaston Massé was elected regional representative of the Corporation of Professional Engineers. He succeeds George Dick whose term of office had expired.

At the E.I.C.-C.P.E.Q. joint meeting held in Sherbrooke on November 11. Front row, left to right, R. D. Mawhood, vice-chairman; J. Lemieux, chairman; G. Lorne Wiggs, C.P.E.Q. president; Dr. A. Crépeau, honorary chairman; and G. M. Dick, honorary chairman. Back row, left to right, J. P. Champagne, secretary; R. Painchaud, G. L. Côté, Léo Roy, Rev. Brother Léandre, G. Massé, and Pierre Bournival.

Fredericton

O. I. Logue, M.E.I.C.,
Secretary-Treasurer
N. E. Donahoe, Jr.E.I.C.,
Branch News Editor

Panel Discussion on Traffic

The November meeting of the Fredericton Branch was held on the 21st of the month at Colwell's Inn, with about 40 members present.

Professor H. W. McFarlane, chairman of the Fredericton Branch, presided. Following a short business meeting, a panel discussion took place concerning the traffic problem in this city.

Members of the panel were Bill Barrett, city engineer, C. E. Weyman, alderman, B. Barker, chief of police, and John Evans, chairman of the Junior Chamber of Commerce. Professor McFarlane acted as chairman.

Problems and Improvements

The panel opened the discussion stating the various problems which exist in this city, such as blind crossings, heavy

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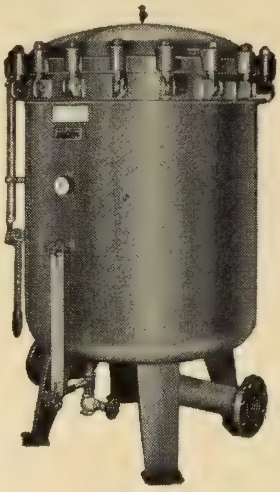

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*uniform bearing capacity

THE COMPLETE FLEXIBILITY of Raymond Concrete Piles as to length permits all piles to be driven to a uniform resistance regardless of variations in depths of bearing soils. Raymond Piles are available in an endless variety of lengths through combining step-taper sections of different lengths or joining step-taper sections with pipe or wood lower sections. Because the piles are cast-in-place, time is saved (and cost reduced) by eliminating the driving of test piles to predetermine lengths, as well as eliminating the delay due to casting and curing of precast piles.

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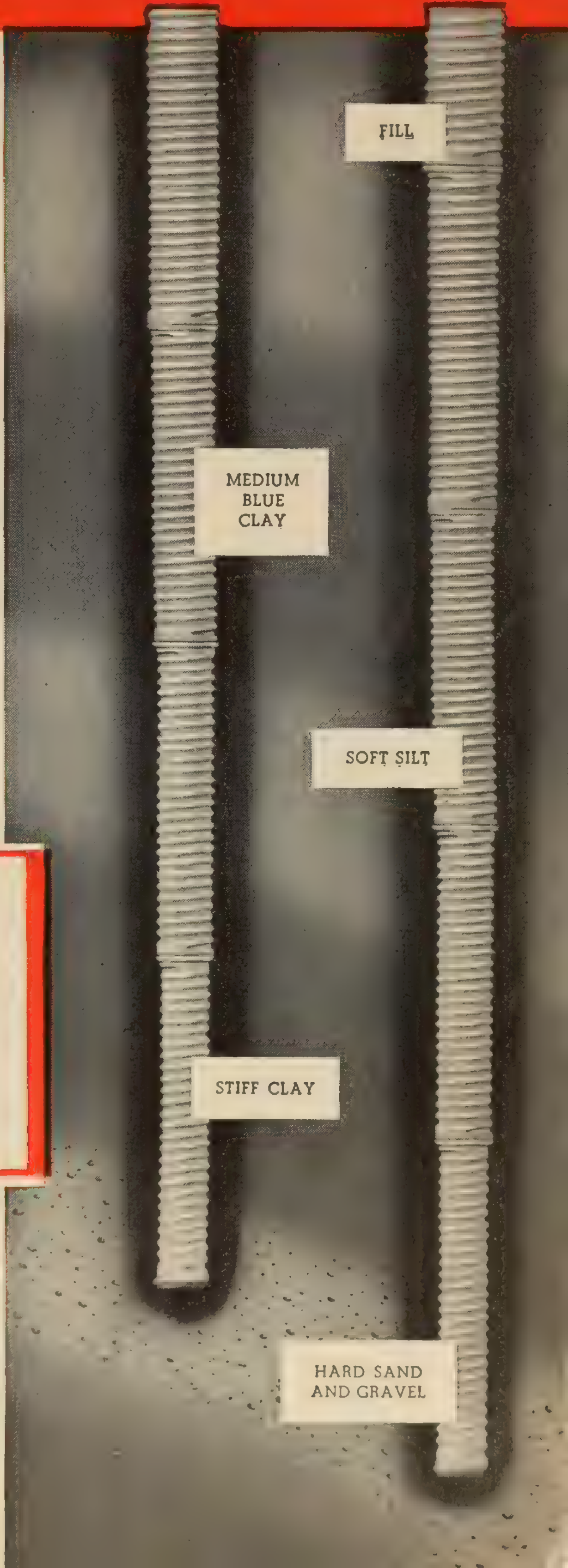

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traffic on certain streets, etc. The panel indicated what had been done to date in the way of improvement in speeding up traffic, in control lighting, as well as other aids.

Then the members questioned the panel and several interesting opinions and suggestions were forthcoming.

Commission Proposed

In concluding, Professor McFarlane said that a commission of responsible and technical men, well qualified in traffic problems should be set up to study the existing regulations, keeping in mind the growth of the city and the passing through of the Trans-Canada Highway.

After the meeting a lunch was served.

Hamilton

A. F. Barnard, jr.E.I.C.,
Secretary-Treasurer

Ross R. Packer, jr.E.I.C.,
Branch News Editor

Civil Defence Is Discussed By Brig. Todd

At the November dinner meeting in the Wentwork Arms Hotel the guest speaker for the evening was Brigadier P. A. S. Todd who discussed the subject of civil defence in Hamilton. Brigadier Todd, general manager of the Hamilton Transit Company and co-ordinator of civil defence for the Hamilton area, was introduced by D. Annan.

Brigadier Todd, who commanded the artillery of the Third Division during the second World War, stressed the duty of the Civil Defence organization to present its plans to citizens in view of the seriousness of any panic. Unfortunately Civil Defence is a misnomer, he said, in that the organization does not defend but goes into operation after a disaster has taken place.

Disasters

The types of disaster which may take place are a natural disaster, which is unlikely, due to Hamilton's geographical situation; a commercial disaster, which may take place at any time; or a hostile act in time of war. Consideration of the weapons in use must be given when planning for a possible hostile act. With the advent of A and H bombs, wardens have been felt unnecessary due to the fact that the whole city may be destroyed at once. Coventry, for example gave up the idea of civil defence in 1950. Hamilton decided to disband her wardens also.

Immediate Evacuation Impractical

This is the general opinion in Canada. The immediate evacuation of Hamilton upon the warning of an air attack, for instance, is impractical. Hamilton is in line with large eastern American industrial centres; near Lake Ontario which is easily recognized; and is in a vulnerable position should bombs miss their original targets. It has been estimated that with the aid of detection stations 2,300 miles north of Hamilton, and with planes flying at the rate of 700 miles per hour, the city would be permitted about three hours' warning only. It would be impossible to move 225,000 people out in so little time. It would involve the separation of families and the lack of food and shelter. Without shelter they would be exposed to radiation, and lacking medical attention.

Air Supremacy Essential

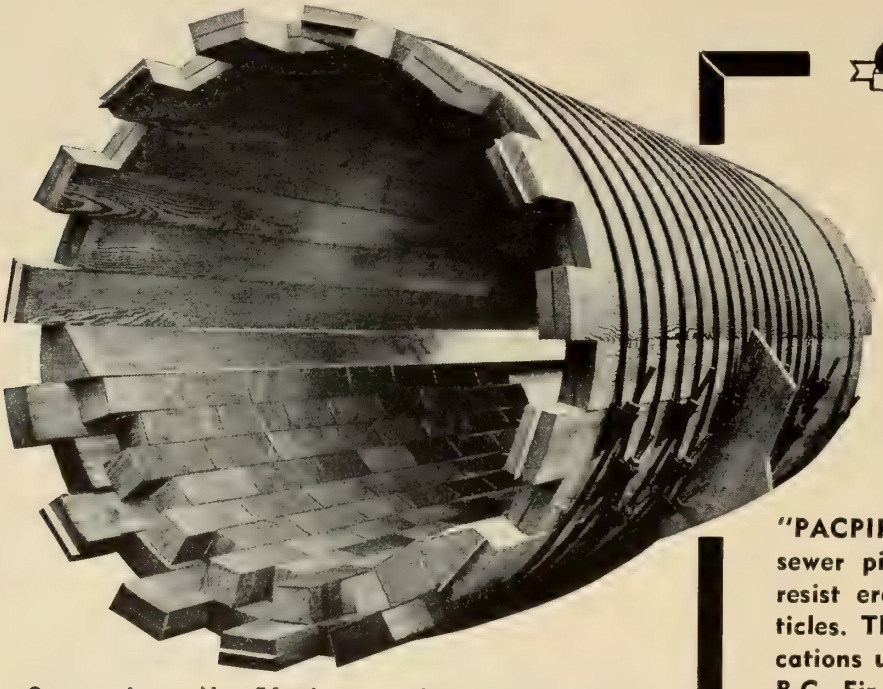
Several years ago it was realized that wars can be fought only with arms and supplies. Factories could not be deserted. The greatest defence, therefore, was air supremacy.

The uranium bomb, which is 140 times less expensive than the H bomb, and whose radiation extends 7,000 square miles, has influenced the civil defence plans developed in Hamilton.

It has been estimated that there are only 200 cities essential to war production. These could be destroyed with a minimum of 2,000 aircraft during approximately four to five days. Under these circumstances, factories mean nothing. For this reason, Civil Defence is considering evacuation before a war even starts.

Commercial Disaster

Of course, a commercial disaster can take place at any time. The work of



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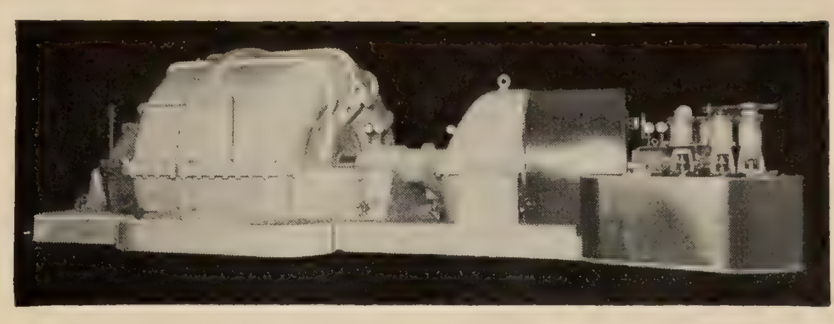

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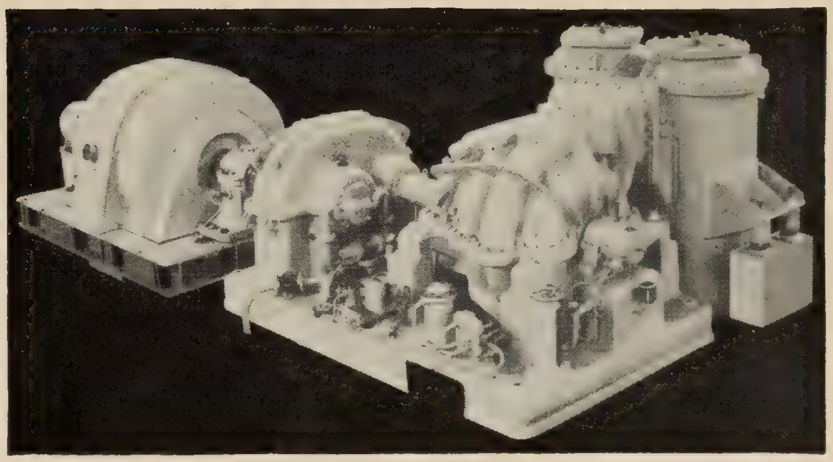

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Civil Defence is that of co-ordinating existing services such as the fire and police departments, city engineering and the hospitals. Possibilities for commercial disaster are likely to increase with the development of Hamilton's harbour. Should such a disaster occur, Hamilton can make use of the services of neighbouring cities.

The Hamilton General Hospital is now equipped to handle 500 accident cases in four hours. By arrangement with the Bell Telephone Company the hospital can obtain 40 main lines. These were previously limited to four. In case of disaster, lists of necessary supplies to be ordered from many sources in Canada have already been prepared.

During the question period which followed Brigadier Todd's address, it was pointed out that the funds for Civil Defence in Hamilton are obtained from the municipalities (25%), from the Province of Ontario (25%) and from the federal government (50%).

Kitchener

John R. Runge, m.e.i.c.,
Secretary-Treasurer

J. L. Fair, m.e.i.c.,
Branch News Editor

Seaway Discussed by J. R. Montague

J. R. Montague, director of engineering of the Hydro-Electric Power Commission of Ontario, addressed the November meeting of the Branch. His topic was "Technical Aspects of the St. Lawrence Seaway" which was illustrated with slides showing some of the construction activities.

In spite of the immensity of the project and the many new problems to be solved, he said, it is expected that cost per kilowatt will not exceed that of other recent developments. Mr. Montague called attention to the impact of the Seaway on the economy of the St. Lawrence valley and the large investment involved in completing the power and navigation features of the project.

Relocation Work Described

A novel feature of the construction that was illustrated was the moving of houses on the large and rapid scale required to relocate the residential and industrial areas to be covered by the final water levels.

Light refreshments and a social hour were enjoyed after the meeting.

Montreal

G. M. Boissonneault, m.e.i.c.,
Secretary-Treasurer

M. Benoit, m.e.i.c.,
Publicity Chairman

Automation, Automatons and Men

On October 25 the Management Section of the Montreal Branch sponsored a meeting at which Dr. J. J. Brown of Aluminium Limited spoke on advanced methods of automatically operated assembly line production. The meeting chairman was George M. Foster of the Northern Electric Company.

The speaker gave an excellent treatment of the subject. Dr. Brown first defined automation and automatism. He favoured automation and declared that its incoming in industry was inevitable. Automation will lower production costs and reduce the number of workers. It will affect non-skilled labour and repairmen, but will develop a more diversified field of products which should absorb the surplus of workers. A long discussion followed from the large group present.

The vote of thanks was extended by J. Gray of the Northern Electric Company.

The Problem of Stream Pollution

On November 17 the Chemical Section of the Montreal Branch sponsored a panel discussion on stream pollution. The panel speakers were introduced by Chairman K. B. Owens, chemical sales engineer for Monsanto (Canada) Ltd.

Dr. L. Piché

The first speaker was Dr. L. Piché, director, Department of Chemistry, University of Montreal. A comprehensive account was given of the causes of stream pollution and of the various methods used to indicate the type and degree of pollution, a necessary matter since these factors must be known before any concerted drive to clear the stream can be undertaken. In a more detailed coverage of the Ottawa River, charts and graphs indicated the location and degree of pollution present in the river below Ottawa. Emphasizing these points, Dr. Piché described both the Lower Ottawa and the North River at Montreal as "open sewers" in parts of their courses. It was very clearly demonstrated that both municipal and industrial sources were prime factors in the deterioration of water quality.

H. Clare

H. Clare, technical superintendent, Imperial Oil Company, outlined the methods by which the petroleum industry is attempting to reduce or eliminate the sources of stream pollution inherent in refining processes. Refineries handle millions of gallons of water per day and the problem of releasing these waters in the state received is one of varied mechanical or chemical treatment. The treatment plants required, while extensive and expensive, are part of the industry's obligation to the public. As well, a Pollution Control Committee, set up in 1943, co-operates with provincial governments in surveys which concern the industry.

D. Jones

D. Jones, speaking for the Canadian Pulp and Paper Association, covered the problem as related to that industry. Pollution causes are partly chemical, partly mechanical, and the industry is attempting by better processing methods to use more of its presently wasted materials. Much time and money is being expended in efforts to reduce pollution, but it was suggested that government and industry should co-operate in overall stream assessment, and that rather than restrict the industry

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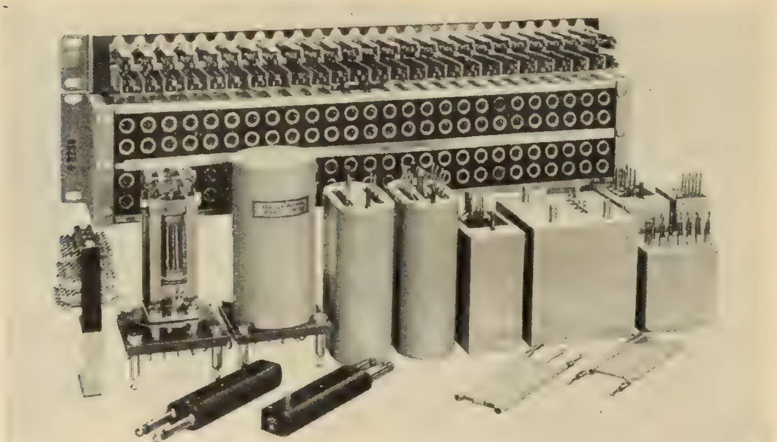

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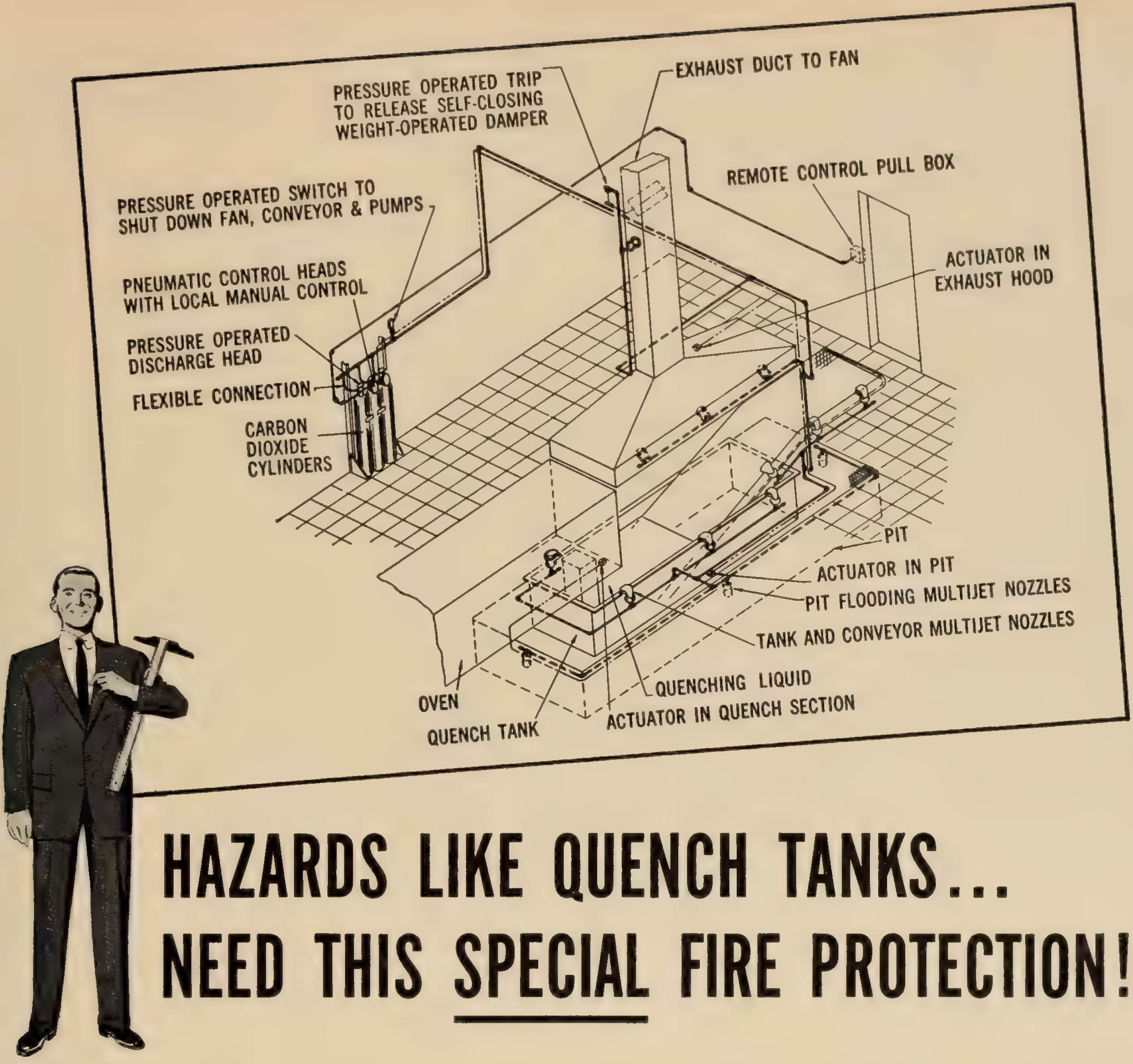
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• Branch News

unduly, controlled pollution of certain river areas might be the answer in some cases.

D. Kirkbride

D. Kirkbride, development manager, Canadian Industries Limited, covered the development of pollution control by governments. Legislation and increasing industrialization go hand in hand. England began as early as 1814, and both the U.K. and the U.S.A. have steadily increased the range of pollution controls, with Canada beginning to feel the same need. It was emphasized that increasing problems make present legislation inadequate and new laws must be passed to enable industry and government to handle the problem in co-operation.

The small crowd made up for its lack of numbers in a spirited and lengthy discussion period lasting almost to midnight.

H. R. Stokes-Rees of Hydro Technic Ltd., thanked the speakers for the wide coverage of the subject. Meeting arrangements were by L. A. Phillips.

Linoleum Manufacture

On Tuesday, October 11, O. R. Brumell, spoke on "Linoleum Manufacture" to a highly interested audience. Marc Benoit introduced the speaker.

After a brief history on the manufacture of linoleum, Mr. Brumell entered into detail of modern methods used to produce the material.

He explained the differences in the types of backing, discussed their relative merits and described fully such parts of the process as printing, drying, etc.

A study on the economic outlook concluded his talk. A lively and instructive period of pertinent questions followed, all ably answered by Mr. Brumell. W. D. Kerr thanked the speaker.

Ottawa

R. F. Legget, M.E.I.C.,
Secretary-Treasurer

Carl B. Crawford, Jr.E.I.C.,
Branch News Editor

Colour Television

Ricardo Muniz, manager of the television-radio division of Canadian Westinghouse Company Ltd., was guest speaker at a luncheon meeting of the Ottawa Branch on November 10. In his talk Mr. Muniz suggested that the future of the T.V. industry lies in colour telecasting. A recent survey indicated that three out of four persons would buy colour T.V. sets if the price were reasonable and programs were available. The price of a 21-inch console set is now about $800. Colour picture tubes cost about five times as much as the equivalent black and white tubes. At the present time there does not appear to be much chance of lowering these prices.

First T.V. Colour Station April, 1956

Mr. Muniz said that the first coast to coast colour T.V. program in the United States was a showing of the "Tournament of Roses" from Pasadena on January 1, 1954. There are at the present time 100,000 channel miles installed for colour T.V. broadcasting. In the U.S. there are about 40 hours per month of colour T.V. programs and this is to be increased to 80 hours per month. In Canada some colour T.V. receiving sets are in use in the Toronto area receiving programs from the U.S. The first all-colour T.V. station is expected to begin operation on April 1, 1956, in Chicago. In Canada, the C.B.C. is delaying any commitments in the field of colour television until demand is sufficient to warrant entering this field.

Development of Colour T.V. Traced

The speaker traced the development of colour television, pointing out that the first development was an entirely new electronic system which would make black and white sets obsolete. For obvious reasons this was not a suitable system and later the development of a system compatible with the black and white system was achieved. Preliminary studies in this development were made in basic physiology of the human eye. Mr. Muniz outlined the basic electronics of television, including the complications of colour television. He pointed out that the number of tubes for colour television would have to be increased from 20 to 28.

Change-over May Be Rapid

There are now about 700,000 television sets in Canada for receiving black and white programs. Most of these sets have 17 inch screens or larger, indicating that much of the early development of television was missed in Canada. In addition to the growing demand for colour T.V., manufacturers are anxious to open up the market for colour television. With the rapid development to maturity of colour television, the speaker thought that the change-over from black and white would be a rather rapid process.

The speaker was introduced by W. B. Pennock, vice-chairman of the Branch, and he was thanked by R. E. Hayes, past chairman of the Branch.

Hon. Robert Winters Is Guest Speaker

The Hon. Robert H. Winters, Minister of Public Works, was guest speaker at the second evening dinner meeting of the Ottawa Branch to be held this season. Mr. Winters, in tracing the history of Trans-Canada highway developments, compared the highway with the building of the first Trans-Canada railway. He recalled that the last attempt to build a Trans-Canada highway was begun in 1930 to alleviate unemployment but that this effort was held up by World War II.

Trans-Canada Highway

Following the war, with an even greater need for a continuous highway link, the federal government, in 1948, invited the provincial governments to discuss ways and means of building a Trans-Canada highway. It was agreed that costs would be shared equally between the provincial and the federal government. Standards of construction were agreed upon. These included a minimum right of way of 100 feet, a minimum pavement width of 22 feet with a 10 foot shoulder, a minimum sight distance of 600 feet and a design axle loading of 18,000 lb. It was agreed that the route should in general cover the shortest distance across the country. Many difficulties, including the Korean war, combined to delay construction until it was evident that the completion date of December, 1956 would not be met. At the present time only about one-third of the highway is completed to the agreed standards. Recently, in consultation with the provinces, the original agreement was extended for another five years subject to parliamentary approval. In order to close the gaps where no highway exists, the Federal Government agreed to contribute 90 per cent of the cost on 10 per cent of the highway mileage in each province. Other construction costs are to remain on a 50/50 basis.

Mr. Winters pointed out some of the special difficulties existing in each province. He said that Ontario had the longest stretch of Trans-Canada highway and also the longest gap where no highway exists. British Columbia had some of the most difficult terrain to cross where costs would exceed one million dollars per mile.

Costs

In reply to questions Mr. Winters said that the 1948 cost estimate of $300 million was now thought to be only about half of the final cost, not including the cost of property. He stated that toll charges would not be made on any parts of the highway to which Federal Government contributions were made.

Mr. Winters was introduced by R. F. Legget, chairman of the Ottawa Branch, and the appreciation of the Branch was extended by K. M. Cameron, a former chairman of the Branch.

Newfoundland

C. W. Henry,
Secretary-Treasurer

Engineers' Wives Club Report

During the year 1954-55 the Engineers' Wives Association, St. John's Branch held six meetings. Our membership now numbers 41 and approximately 20 to 25 members attend our monthly meetings.

The social high-light of our season was, no doubt, the Halloween Dance held at the Chateau on October 29.

To add to our meetings we were fortunate in having on two occasions guest speakers, Miss E. Mallard, head mistress of Bishop Spencer College, and the Hon. R. F. Sparkes, Speaker in the Newfoundland House of Assembly. Mrs. Halme kindly showed coloured movies featuring some of the highlights of her stay in Bolivia at our January meeting, and at our March meeting Mrs. C. W. Henry showed coloured slides which were taken in Venezuela.

Our members continue to show quite an interest in child welfare, and brought many articles of children's clothing, both used and newly knitted. Their contributions were greatly appreciated by the Child Welfare Association.

The Bridge Tournament inaugurated during the previous year, was held again this season. Mr. and Mrs. Grant Jack were winners of the tournament and Mr. and Mrs. Clarence Knight were second.

Unfortunately, we were forced to discontinue the collection of used magazines for the Sanatorium owing to the fact that there were not enough members free to attend to the distribution of them at the hospital.

Our financial status this year was such that we were able to offer a prize of $25.00 to the Engineering Faculty at Memorial University and at the suggestion of Prof. S. J. Carew, this was awarded for Drawing I and was won by Arthur Knight of St. John's.

We continued during the season, to send congratulations to members who had new babies, "Get Well" cards to those who were ill, and messages of sympathy to any who were bereaved.

We also continued the practice of providing refreshments both for our own meetings and for those of the Engineering Institute, Newfoundland Branch.

Presidential Tour

On Friday, Sept. 23, Dr. R. E. Heartz, president of the Engineering Institute of Canada with Mrs. Heartz arrived in St. John's on the presidential tour. They were accompanied by Dr. L. Austin Wright, the general secretary of the Institute and the honorary treasurer E. V. Gage and Mrs. Gage. On Friday morning Mrs. Heartz and Mrs. Gage were guests of honour at a coffee party given by the Engineers' Wives Association at the home of Mrs. V. A. Ainsworth, 10 Forest Road; on Saturday, a luncheon was held in their honour at Bally Haly Golf Club. Preceding the luncheon, Mrs. Clarence Knight on behalf of the Association, presented Mrs. Heartz with a beautiful draw-string bag made by the Jubilee Guild, as a souvenir of her visit to St. John's. In thanking the Association, Mrs. Heartz said how happy she was to have had the opportunity of coming to St. John's and meeting the members of the Wives Club.

On Friday evening the Engineering Institute held a dinner at the Old Colony Club in honour of the distinguished visitors. The members of the Wives Club joined their husbands for the occasion. The dinner was preceded by a reception and followed by dancing at the Club. The presidential party left by plane for Halifax on Saturday, September 24.

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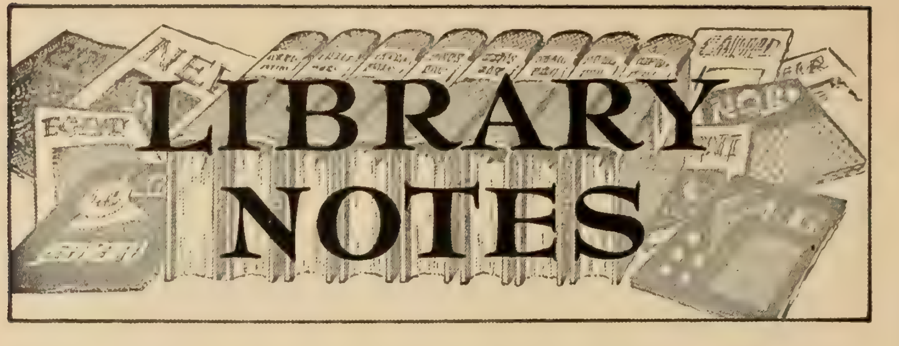


LIBRARY NOTES

Additions to the Institute Library

Reviews — Book Notes — Abstracts

BOOK REVIEW

Diesel engine principles and practice. C. C. Pounder, ed. Toronto, British Book Service, 1955. Various paging, illus., $14.45.

All types of diesel engine from those for tractors to those for marine engines are covered in this volume which was compiled under the editorship of Mr. C. C. Pounder who has been responsible for the machinery designs for over a thousand vessels.

Each of the twenty-six chapters is written by an expert, and each is complete in itself, although each fits into the general scheme of the work.

The first chapters deal with the theory of compression-ignition engines, fuels, scavenge and exhaust systems, transmission gears, governors, bearings, etc. The middle section of seven chapters discusses the various types of engine, whilst the last chapters are devoted to vibration, testing and maintenance.

This is a very comprehensive work which should be in every technical library and which will be most useful to both practising engineers and students. There are many illustrations and diagrams, a detailed index, and bibliographies are found at the ends of most chapters. This is both a text book and a work of reference. S.C.

BOOK NOTES*

Prepared by the Library

The Engineering Institute of Canada

*Book notes marked by an asterisk have been provided through the courtesy of the Engineering Societies Library in New York.

Abstracts of the literature on semiconducting and luminescent materials and their applications, 1954 issue. Battelle Memorial Institute. New York, Wiley, 1955. 200 pp., $5.00.

This compilation of abstracted articles is the second issue and contains over 750 items, taken from various journals and, where possible, from oral papers. Both foreign and American abstracts are included and an attempt has been made to give the most important experimental results or conclusions.

The articles are grouped under the following subjects: germanium, silicon, carbon, boron, and other semiconductors, selenium, and tellurium, selenides and tellurides, intermetalics, oxides, sulfides, halides, organics, fluorescence and phosphorescence, and theory. There are subject and author indices.

Aerodynamics: selected topics in the light of their historical development. Theodore Von Kàrmàn. Ithaca, Cornell University press, 1954. 203 pp., illus., $4.75 (U.S.).

The history of man's efforts to fly has often been spectacular but the behind-the-scenes contributions of engineers and physicists are sometimes overlooked. This book is an account of aerodynamics since Newton's time and particularly during the last fifty years.

The problems of lift, drag, skin friction, stability, aero-elasticity and supersonic aerodynamics are all discussed and reveal the manner in which engineers have met and overcome seemingly unsurmountable obstacles. An interesting aspect of the book is the account of the difficulties which must be met before space travel will become a reality.

The author has been closely connected with the field of aerodynamics, so that his writing has authority as well as high literary quality.

American aviation world-wide directory, v. 16, No. 2, 1955-56. Washington, American aviation publications, 1955. 794 pp., $7.50 U.S.).

The main part of this directory naturally covers aviation companies and officials in the United States, but Canada, Europe, Central and South America, Africa, Australasia and Asia are also represented.

The book is divided into sections covering certificated, intrastate and irregular U.S. air carriers, indirect air carriers, air taxi operators, holders of U.S. foreign air carriers permits, U.S offices of foreign air carriers and air carriers in foreign countries.

The information given on each company includes the address, names of executive officials and managers and a description of the equipment operated by the company.

There are also buyers' guides, and lists of aircraft manufacturers in the countries covered.

Analysis of symmetric cylindrical shells. John McNamee. Ottawa, United Kingdom Information Office, 1955. 84 pp., 12/6.

The lectures which form the text of this book were originally given at Liverpool University and in it the author outlines the theory of thin cylindrical shells for those who are not familiar with the subject. He has also attempted to carry the analysis to the point where it can be used to determine numerical values of the stresses in shell roofs.

In the three lectures unfamiliar mathematical techniques have been avoided if possible. The first deals with elementary analysis and concludes with a short historical account of the theory. In the second chapter matrix analysis is explained while the last is devoted to computations.

***An annotated bibliography on noise, its measurement, effects and control.** Pittsburgh, Industrial hygiene foundation of America, 1955. 364 pp., $7.50 (U.S.).

Over 2,000 references are arranged chronologically under subject subdivision of four major sections: noise measurement, effects of noise, measurement of hearing loss, and noise reduction and control. Most of the references are from the period 1927 to 1953 and include foreign titles as well as English. Representative articles are annotated or abstracted, and subject and author indexes are included.

Basic mathematics for science and engineering. P. G. Andres, H. J. Miser and Haim Reingold. New York, Wiley, 1955. 846 pp., $6.75.

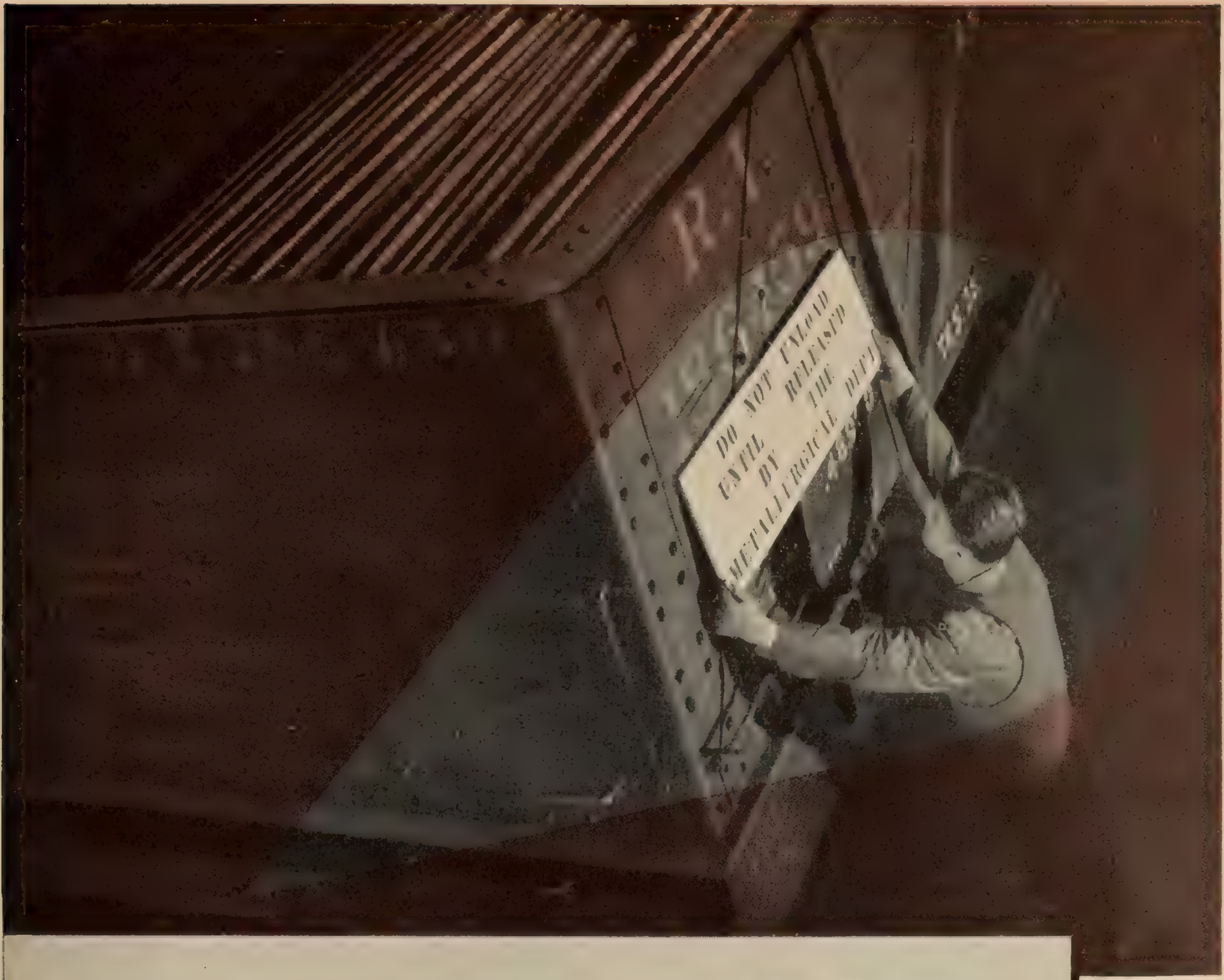
This textbook could serve equally well as an introduction to the mathematics needed for science and engineering courses and as a refresher manual for practising scientists and engineers. It is a revision of an earlier volume published in 1944 under the title "Basic mathematics for engineers".

Topics from algebra, trigonometry, analytic geometry and introductory calculus are dealt with and the material in each chapter is placed in its mathematical and scientific setting. Mathematical principles are illustrated with engineering applications and a great number of exercises are included.

Some of the more useful features are the early explanation of the slide rule, the stress placed on graphical methods, the sections on trigonometric functions, vectors, and the Doolittle method of solving simultaneous linear equations.

Design in British industry. Michael Farr. Toronto, Macmillan, 1955. 332 pp., 87 plates, $11.75.

Because the author condemns a great deal of contemporary British design in industry, with frequent comments on American design as well, this book will be both interesting and controversial. In this survey he includes not only those who conceive and design the pro-



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ducts, but also those who manufacture, market, buy and use them.

The first part of the book deals with specific products such as furniture, metalwork, jewellery, appliances, pottery, and cars. It also discusses the place of the craftsman in industry and includes chapters on consultant designers, the retail trade and art schools. The publicity and propaganda used by design organization form the subject of the second section. The last two sections will create the greatest interest, and arguments, for in them Mr. Farr discusses such questions as design standards and mass production, the taste of the public, snob appeal, etc., and makes many pointed suggestions for improvement in the whole field of industry.

Dichtungen im Stahlwasserbau. C. F. Kollbrunner and Lothar Streuli. Zurich, Leemann, 1955. 34 pp., diagrs.

The subject matter of this German book on seals for steel watertight structures is divided into seven sections. Following the introduction various types of seals are described. Within this section the authors deal with the mounting of packings relative to water pressure, the accessibility of packing at low water level, resilience of packing elements, material for packing and static and moving seals. Two chapters are devoted to older and modern sealing systems, followed by one on mountings. The last part of the book discusses guideways of locks compared to types of seals and measuring water to ascertain the water loss by weirs.

***Electric power stations. Vol. II,** 4th ed. T. H. Carr. Toronto, British Book Service, 1955. 832 pp., diagrs., $12.85.

This second volume of a two-volume treatise on the design, construction, and operation of electric power stations deals especially with the electrical side of the subject—alternators, transformers, reactors, switchgear, cabling, and protective equipment. Three chapters deal with hydro-electric, diesel-electric, and gas turbine plants, and there is a chapter on wind, atomic, and other power plants. Also covered are lubricating, indulating, and fuel oils; auxiliaries; station organization; and costs.

***Gear design and production.** Reginald Trautschold. Columbia, Conn., Columbia graphs, 1955. 204 pp., $4.50 (U.S.).

A restatement of basic principles accompanied by proofs of rules and formulas for critical computations. Each of the various standard classes of gears —spur, bevel, spiral, etc.—are taken up separately, and chapters on methods of production, materials, and inspection are included.

***Hawley's technical speller.** G. G. Hawley and A. W. Hawley, comps. New York, Reinhold, 1955. 146 pp., $2.95 (U.S.).

This book contains over 8,000 technical words selected from the vocabularies of chemistry, physics, electronics, biology, medicine, engineering, and other fields of science and technology. Recommended word divisions are indicated. A separate list gives the correct prepositions for use after certain words.

Industrial management, 5th ed. W. R. Spriegel and R. H. Lansburgh. New York, Wiley, 1955. Various pagings, illus., $6.75.

In this edition much of the material has been rewritten and rearranged for better use in study and reference. There are new chapters on job evaluation and statistical quality control.

As in previous editions both theory and practice in management are discussed, with policies and principles forming a background for methods of putting them into successful operation. The book is divided into nine sections, beginning with a history of the managerial movement and going on to organization structure, problems concerning the product, the plant and equipment, motion and time study, wages and basic relations between employers and employees, buying, selling and cost controls, material and production control, and finally, personnel administration and management.

The text is generally geared to the point of view of the medium-sized plant with frequent references made to the large and small enterprise. Examples and illustrations have been chosen from a diverse group of industries.

Industrial power systems handbook. Donald Beeman, ed. Toronto, McGraw-Hill, 1955. 971 pp., diagrs., $15.50.

Because of the vast amount of commercial and industrial building going on today this book will answer a wide demand for an authoritative aid to designing electric power distribution systems. The editor has contributed helpful data from General Electric Company experience and the sixteen specialists cover all major phases of power system design.

The first part of the book contains technical information while the latter part is devoted to economic or system design information. There are chapters on short circuit calculations and protective devices, methods of voltage regulation and on system and equipment grounding. Various angles of economy are discussed, ranging from the cycles and economies of methods of generating by-product power from waste fuel or process steam, to cost load and cost estimating data for systems and commonly used equipment components.

One interesting section describes methods of modernizing and expanding existing power systems and suggests ways of applying modern power principles to commercial and office buildings, with many examples and case histories of such power system practices.

Many of the application data are in condensed tabular and curve form to aid in the practical solution of problems.

Introduction to TV servicing. H. L. Swaluw and J. Van Der Woerd. Eindhoven, Philips, 1955. 264 pp., illus., $5.50.

Although this manual refers to the European 625-line system, the theory, description of the TV receivers and the service information which it contains may be applied to the American 525-line system.

To make full use of this book radio service technicians should have a sound knowledge of circuit fundamentals. There is a theoretical introduction before the practical problems are presented and in it we find a short explanation of the scanning system, the working of the picture tube and the waveform of the TV signal. Several chapters then describe a modern TV receiver with separate sound channel and a section is devoted to intercarrier sound and the turret tuner with cascode amplifier.

The larger part of the book describes measuring instruments and the tracing of faults in the defective receiver. The illustrations include a series of photographs of screen pictures as they appear on incorrectly adjusted or faulty receivers.

Municipal organization in Canada. T. J. Plunkett. Montreal, Canadian federation of mayors and municipalities, 1955. 157 pp.

While this book was not written especially for the engineering profession it is, nevertheless, a valuable addition to an engineering library. Many administrators, sales engineers, contractors, etc., must deal with municipal government bodies and this up-to-date volume on local governments in Canada will greatly assist them.

The means by which municipal government is carried out differs greatly from province to province as well as between municipalities in the same province. The author has analyzed these different forms and discusses the various systems used to administer local community services.

Following a general chapter on the purpose and elements of municipal government Mr. Plunkett describes the council committee system, the council-manager system, the council-city commissioner system and the board of control plan. He also discusses the problems of these bodies.

The appendices form a valuable addition to the main text, describing the forms of government in the main cities of Canada. These are followed by municipal organization charts of the same cities.

Principles of farm machinery. Roy Bainer, R. A. Kepner and E. L. Barger. New York, Wiley, 1955. 571 pp., illus., $8.75.

In an attempt to present the subject of farm machinery from the engineering viewpoint the authors have included a minimum amount of descriptive material. Their book is intended for agricultural engineering students with a previous knowledge of static mechanics, who are also familiar with the common types of farm machinery. General discussions of materials, power transmission, economics, and hydraulic controls are included.

Where possible, machines for a particular practice such as planting, are treated on the basis of the unit operations performed by the functional elements of the machine.

Among the specific types of machinery discussed are those employed for earth-moving, soil tillage, crop planting and cultivation, application of fertilizers, hay harvesting, seed cleaning and harvesting, corn picking, spraying and dusting, and farm transport.

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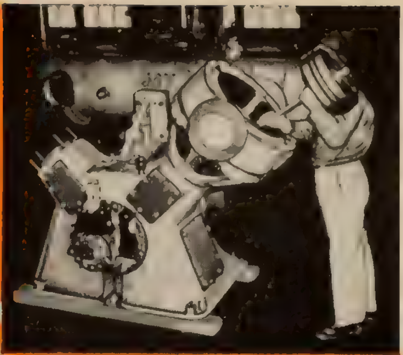

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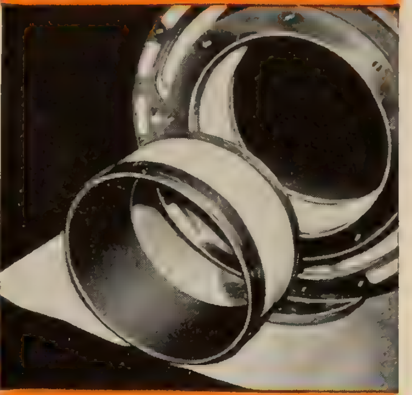

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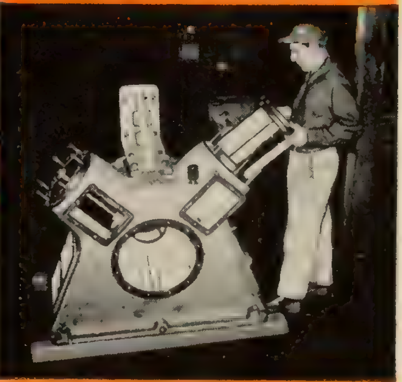

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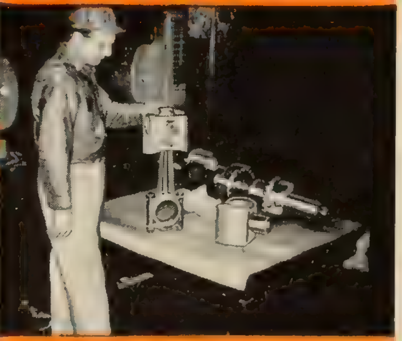

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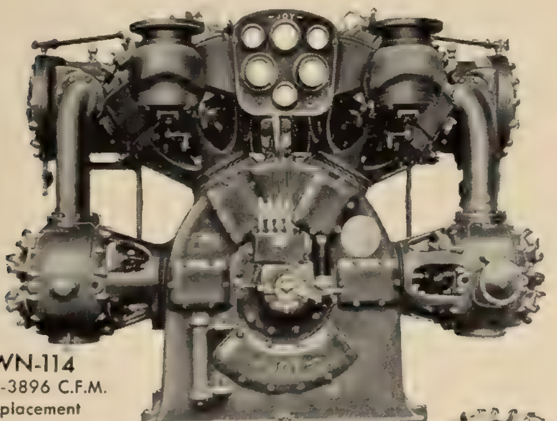

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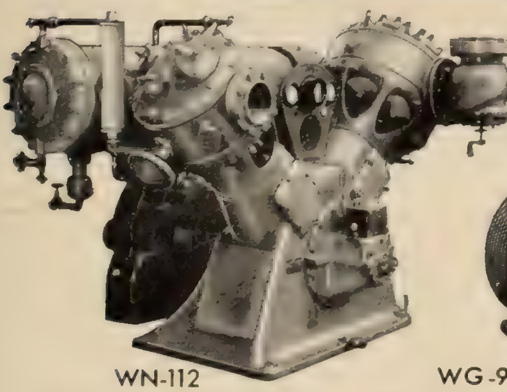

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*****Principles of nuclear reactor engineering.** Samuel Glasstone. Toronto, Van Nostrand, 1955. 861 pp., illus., $8.75.

This is a broad, over-all review of fundamental scientific principles, prepared for engineers who wish to know something of the impact of nuclear energy on their professional activities It may also serve as a text for senior and graduate students. The separate chapters cover essentials of nuclear physics, reactor theory, instrumentation and control, fuels and materials, and various associated problems of reactor design. A number of existing reactors are briefly described in the last chapter.

Principles of technical electricity, 2nd ed. M. Nelkon. London, Blackie, 1955. 250 pp., illus. 10/6.

Written for students, this is a general presentation of the fundamental principles of electricity with reference to its technical applications.

The book deals with two main topics: d.c. and a.c. theory. In the former section are described the heating, chemical, and magnetic effects of current, electrical measurements and instruments, and the principles of condensers. The a.c. circuit theory deals with series and parallel circuits of coils, condensers and resistors and applications of this theory to typical radio circuits is stressed.

In this second edition an appendix has been added on the M.K.S. system of units and some changes have been made in the main text.

*****Problems and control of air pollution; proceedings of the First International Congress on air pollution.** F. S. Mallette, ed. New York, Reinhold, 1955. 272 pp., $7.50 (U.S.).

These proceedings papers, presented by experts from seven countries, provide new and authoritative information on a wide range of subjects of interest to engineers, municipal officials, management, and others concerned with reducing or eliminating air contamination. Two papers review the British smog problem and public relations aspect of air pollution control; the remaining twenty-three cover specific topics relating to gaps in available knowledge, current research findings, the treatment and recovery of sulfur dioxide, and experiences abroad. Bibliographies accompany many of the papers.

*****Proceedings of the American power conference, volume XVII, 1955.** Chicago, Illinois institute of technology, 1955. 722 pp., $6.00 (U.S.).

As in previous years the papers in these proceedings emphasize the practical rather than the theoretical view and range from the technical to the economic and social aspects of power generation, transmission, and distributions. Grouped by sessions — general interest, nuclear energy, mechanical, water technology, and electrical — the individual papers deal with such subjects as scientific manpower, sodium graphite reactor power plants, power plant stacks under wind loading, small gas turbines, the St. Lawrence Seaway, computing devices, and many others.

Productivity measurement, v. 1: Concepts. European productivity agency. Toronto, Ryerson, 1955. 143 pp., $1.00.

The first volume of this work discusses the various concepts of productivity measurement. Their practical application will be the subject of the two volumes to follow.

In this volume each of the contributions is an attempt to define the meaning of productivity and the problems involved in the measurement of production are discussed at length. The role of official statistics in measuring productivity is the subject of one chapter while another deals with the correlation between productivity, efficiency and wages.

The appendices contain studies by experts on the relationship between the ideas of "labour productivity" and "integrated labour" and on the possibility of making international comparisons in terms of man-hour purchasing power.

Review of current research and directory of member institutions, 1955. New York, American society for engineering education, Engineering college research council, 1955. 352 pp., $2.00 (U.S.).

Although none of the 105 engineering schools included in this review is in Canada it will, nevertheless, be of value

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and interest to faculty members and students of the universities in this country.

The institutions are listed alphabetically and under each there is information on the names of responsible administrative officers, policies governing research projects and contracts, personnel engaged in research activities, annual expenditures and sources of income for research, as well as the 5,000 entries of research project subjects.

Single-enterprise communities in Canada. Queen's university. Institute of local government. Ottawa, Central mortgage and housing corporation, 1953. 312 pp.

This is a "first of its kind" and extremely interesting report on Canadian communities established by government or industrial concerns. The rapid expansion in our northland and in other previously unsettled sections of the country has focused attention on living conditions which exist in these communities, especially as they might differ from the general situation.

The report describes the founding of single-enterprise communities, their local government, town planning, company housing, recreation, community institutions, utilities and services, and social problems. The final chapter contains a series of conclusions and recommendations.

An appendix lists these communities, giving the names of each townsite, founder, economic activity, population, year established, number of company-owned housing units and the percentage of these in relation to total housing, and type of local retail outlet, whether operated by the company or by independent enterprise.

Symposium on sinter. London, Iron and steel institute, 1955. 200 pp., illus., 37/-. (Special report No. 53.)

The seventeen papers contained in this report describe the process of sintering and reveal the extent of industrial research which has been directed toward increasing the productivity of sinter plants. The last three papers, published since the Symposium was held in 1953, discuss the practice of sintering.

The papers dealing with the physics and chemistry of sintering include discussions of the mechanism of reduction of iron oxides, the softening of iron ores at high temperatures, and radiographic studies of the process of sintering iron ores.

The next seven papers describe the production of sinter in terms of permeability of sinter beds, permeability tests on blast-furnace raw materials, faster sintering of ironstone, rating of sinter plants for economic output, and ironmaking from high-sinter burdens.

Theory of machines. W. G. Green. London, Blackie , 1955. 1,034 pp., diagrs., 40/-.

This is primarily a textbook and contains many worked examples. The author's aim has been to preserve a logical sequence throughout the seventeen chapters of the book. These begin with the kinematics and kinetics of a particle then go on to treat rigid bodies and the kinematics of machines. There are sections on the direct-acting engine mechanism, the balancing of machines, governors, valves, friction and lubrication, brakes and dynamometers and the motion of vehicles, higher pairing, cams and cam motions, vibrations of mechanical systems and motion in three dimensions.

World airline record, 5th edition, 1955. Chicago, Roadcap, 1955. 500 pp., illus., $17.50 (U.S.).

This edition has been expanded to include discussion of 269 regularly scheduled airlines which, it is claimed, represents 100% coverage of the world. Additional space has been given to explanations of individual airline problems and route maps have been brought up-to-date.

The book is arranged alphabetically by continent then by country. The data for each airline is arranged under systematic headings including route map, history and development, management, traffic analysis, seasonal chart, income account and historical statistical summary. An effort has been made to present comparable statistical data for all airlines although the difficulties of doing so, especially in the field of financial accounts, is apparent.

TECHNICAL BULLETINS AND PAMPHLETS RECEIVED

Concrete

The durability of concrete under frost action. E. G. Swenson. (Canada. NRC. Div. of bldg. res. Tech. pa. 26) 25 cents.

Practical method of concrete mix design. L. B. Mercer.

Electrical engineering

Automatic noise-factor meter. Henry Wallman. (Chalmers tekniska hogskolas. Handlingar, n. 161.)

A direct-indicating phase meter. A. van Weel. (Philips' Separaat No. 2255.)

Electrical plant for power generation. General Electric Co. Ltd. of England.

General Electric Co. Ltd. 55th annual general meeting. The chairman's speech, by Sir Harry Railing.

The present . . . the future . . . General Electric Co. Ltd. of England.

On the noise of fluorescent lighting installations. E. W. van Heuven. (Philips' Separaat no. 2275.)

Engineers

A criticism of the technical education of recently qualified engineers. P. P. Love. (I. Mech. E. Advance pa.)

The engineer's contribution to the conservation of natural resources. Sir Harold Hartley (I.C.E. The Graham Clark Lecture, 1955).

Patent law. United States

Patent information. Gustave Miller.

Roads and streets

The Washo road test—Part 2: test data, analyses, findings. (U.S. Highway research board. Special report 22.)

Television

TV field service manual, v. 5. Harold Alsberg, ed. (Rider pub. n. 155-5.)

TV repair questions and answers; sync and sweep circuits. Sidney Platt. (Rider pub. n. 173-3.)

Waves, water

Laboratory and field tests of sounding leads. G. M. Watts. (U.S. Beach erosion board. Tech. mem. 54.)

Laboratory data on wave run-up and over topping on shore structures. Thorndike Saville. (U.S. Beach erosion board. Tech. mem. 64.)

Laboratory study of wind tides in shallow water. O. Sibul. (U.S. Beach erosion board. Tech. mem. 61.)

A study of sediment sorting by waves shoaling on a plane beach. A. T. Ippen and P. S. Eagleson. (U.S. Beach erosion board. Tech. mem. 63.)

Miscellaneous

Alfred P. Sloan, Jr., Fifteenth Hoover Medalist. (New York. ASME. Hoover Medal board of award.)

Gunite; durability, economy, flexibility, specifications, and recommended practice. (Gunite contractors assoc. Brochure G-55.)

The impact of the development of atomic and thermo-nuclear weapons on the Royal Navy. J. R. H. Bull, (N.E.C.I.E.S. Advance pa.)

Influence of propeller clearance and rudder upon the propulsive characteristics. H. Lindgren, ed. (Swedish state shipbuilding experimental tank. Pub. n. 33, 1955.)

Progress reports of investigation of railroad rails and joint bars. R. E. Cramer and R. S. Jensen. (Illinois. Univ. Eng. exp. station. Reprint series, n. 54.)

Seventh international conference on ship hydrodynamics. H. F. Nordstrom and Hans Edstrand, eds. (Swedish state shipbuilding experimental tank. Pub. n. 34, 1955.)

Tentative calendar of evening lectures on science and technology to be held in Ottawa for the season 1955-56, v. 1, n. 1.

The following publications have also been received by the library.

Annual reports, proceedings, etc.

British electricity authority. Annual report and accounts, 1954-5.

Canadian electrical association. Sixty-fifth annual convention, 1955, proceedings.

Quebec 1954, a report from the Quebec bureau of statistics.

Montreal. Civil service commission. Tenth annual report for the fiscal year ending April 30th, 1955.

Massachusetts institute of technology. The reports of the president and of the deans of the schools for the year ending October 1, 1955.

Smithsonian institution. Annual report, 1954.

Bibliographies

A preliminary annotated bibliography on muskeg. I. C. MacFarlane, comp. (Canada. NRC. Div. of bldg. res. Bib. n. 11.)

Seaway bibliography and supplement. (Saint Lawrence seaway development corp. Office of information. SLSDC-28 and SLSDC-28-A.)

Supplemental unemployment benefits. (Princeton Univ. Industrial relations section. Selected references, n. 66.)

The writings of David Barnard Steinman; a bibliography. (Rensselaer polytechnic inst. lib. Eng. and science series, n. 67.)

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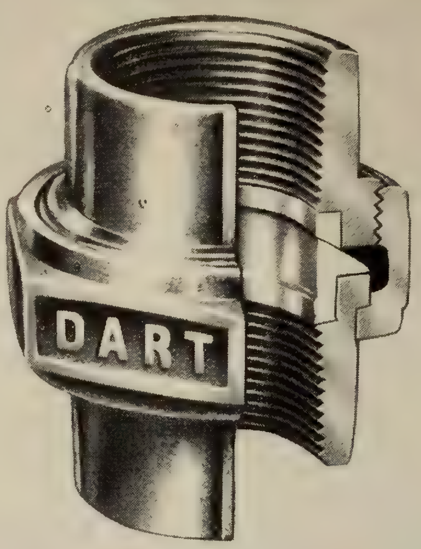

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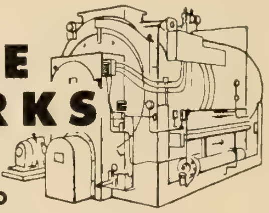
Installation cost. Baffleless Napanee package boilers are lighter, less costly to ship, easier to handle and place.

Maintenance cost. Again, no baffles to burn out, leak and cause a "short circuit" of gases. Instead of baffles, these boilers have hinged front and rear doors. Both doors can be opened by one man in a matter of minutes giving quick access to all fire and heating surfaces, cutting maintenance and shut-down time right to the bone.

There just isn't room to give you all the facts about low cost Napanee package boilers—about our Canada-wide sales engineering set-up for sound advice and service — about our complete boiler range from 10 to 500 HP. But if you write to us for full data and specific prices, we'll be glad to send you everything we have for your files, including the names of customers near you for first-hand opinions on our boilers! 5506



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ENGINEERING CAREERS

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Today, more than ever, engineering services play a prominent and essential part in the efficiency of a modern air force. The highly complex nature of aircraft and their ancillary equipment demands a wide range of technical knowledge and skill.

Canada as a nation emerged from the second world war in a leading position in aviation. Within her borders she had built vast facilities to accommodate the British Commonwealth Air Training Plan, and in military operations on both coasts and overseas, the RCAF made a remarkable contribution to victory and established an enviable record of achievement. In the five years following 1939, the RCAF expanded from a peacetime nucleus of some 4,000 personnel and a few aircraft to a wartime force of nearly 250,000 personnel and several thousand aircraft.

All this was made possible because of the teamwork that was developed between the scientist and the engineer who conceived and designed the fighting equipment, the employer and factory-worker who manufactured it, and the aircrew and groundcrew who maintained and operated it effectively against the enemy. The part played by the service and civilian engineers through all stages, from drafting board to active operation was vital.

In the RCAF today, the engineer, or technical officer as he is known, plays an even more prominent and increasingly important role in the design, development, testing, modification, construction, and utilization of Air Force facilities and equipment.

The primary responsibility of the RCAF is air defence, and, therefore, a large proportion of its resources are devoted to this task. To meet this responsibility Canada has built up her CF 100 all-weather-fighter-interceptor squadrons and her vast network of early warning radar units. These squadrons and radar units form the backbone of the RCAF's Air Defence Command.

To the North Atlantic Treaty Organization, the RCAF contributes an air division in Europe of 12 F86 fighter-interceptor squadrons, their equipment and personnel and land-based maritime aircraft for the protection of coastal and sea-lane communications. NATO aircrew training, air transport, search and rescue, survival training, air photographic and tactical air operations are other active and important roles of the RCAF. With the advent of new operational concepts and techniques, it is obvious that today's RCAF must keep at least one step ahead of any potential enemy. This can only be done if the force is provided with the finest and most advanced equipment available. The responsibility of the service engineer in making this equipment available when it is needed is paramount to the whole Air Force effort.

THE ENGINEERING BRANCHES

Engineers in the RCAF are grouped in the aeronautical, armament, construction, telecommunications, mobile equipment and photography branches. Nearly 1,500 technical officers are required to man these branches. This number will probably increase as further technological advances are made.

To qualify for entry into one of the engineering branches of the RCAF, an applicant must hold a degree from a recognized University in pure or applied science. Once he is enrolled he is given specialized training to adapt him to the specific requirements of the branch in which he wishes to serve. However, professional knowledge alone is not enough since in the Air Force the engineer must also possess qualifications of leadership and management so that he is able to supervise and handle men as expertly as he can materiel. During his career he will be required to fill a staff engineer position at a Command or Headquarters level and to take charge of men and equipment in the field.

Each of the engineering branches maintains its identity, but all are part of a closely knit team whose function is to discharge the Air Force's responsibility as efficiently and effectively as possible. A discussion of each branch's specific task and responsibility follows.

Aeronautical Engineering

Officers of the Aeronautical Engineering Branch of the RCAF participate in the formulation of policy and plans pertaining to the maintenance of service aircraft and associated equipment. Their responsibilities include the drafting of designs and specifications, the conducting of tests and development programmes, the supervising of engineering aspects of production, quality control and technical training. Duties also include the managing of aircraft maintenance organizations which involve responsibility for the servicing, inspection, repair, modification, preservation and service evaluation of aircraft and associated equipment.

Armament

The Armament Branch of the RCAF is responsible for the procurement, installation and maintenance of the airborne and ground armament systems which give the RCAF its striking and defensive power. Officers of this branch participate in policy and programme formulation with regard to the maintenance of armament equipment, armament sections and units and the operation of armament training facilities. Their duties include the preparing of equipment designs and specifications, estimating requirements, advising on the development and use of armament equipment, service trials and testing, quality control and technical training. Duties concerning the management of armament organizations involve technical and supervisory responsibility for the inspection, servicing, fault analysis, repair, modification, storage, demolition, salvage, re-conditioning and preservation testing and development of armament equipment.

Armament equipment consists of such weapon systems as guided missiles, homing torpedoes, drone targets and their guidance and control mechanisms, launching equipment and test equipment; explosive stores, electrical and mechanical fuses; pyrotechnic compositions and components; special weapons (atomic, biological and chemical) and flame warfare agents; guns and unguided rockets, turrets and launching gear; armament range facilities which include telemetering equipment, photo theodolites, electronic-optical analyzers, timing systems and calibrators; aircraft fire control systems and weapon directing radar devices.

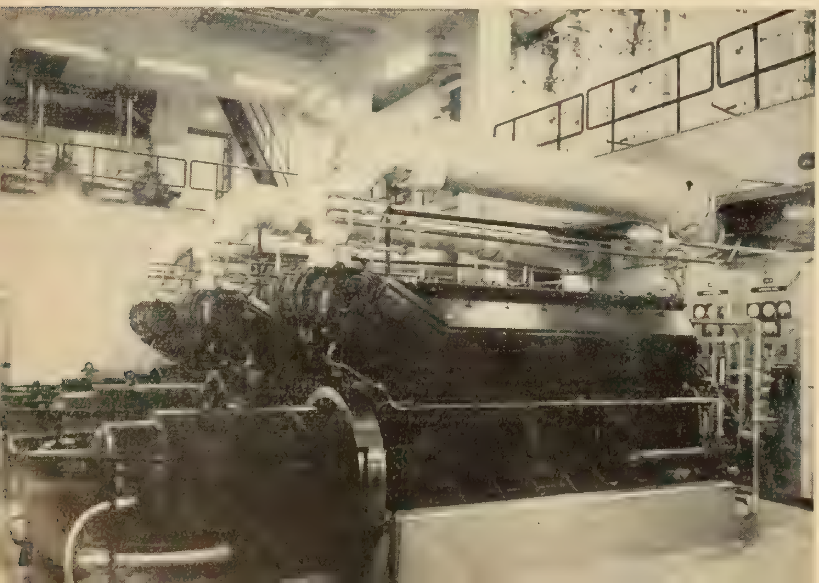
An R.C.A.F snowblower keeping an aircraft parking area clear at R.C.A.F. Detachment Resolute Bay, Cornwallis Island, N.W.T.; the responsibility of the mobile equipment engineer. *(National Defence Photo)*

Construction Engineering

The duties of officers of this branch cover a wide scope of activities in construction, and the operation and maintenance of structures and facilities. Officers of this branch participate in the formulation of construction and maintenance policies, programmes and procedures, prepare construction specifications, standards and estimates of costs, exercise administrative control of construction and maintenance funds and material, recommend acquisition and disposal of Air Force real property, maintain liaison with agencies involved in Air Force construction projects and inspect completed projects as a basis for acceptance, control fire-fighting, fire prevention and aircraft crash rescue services, provide trade training and manage Air Force construction projects and unit construction engineering sections.

This branch has two specialties: (*a*) Construction and Maintenance; and (*b*) Fire Protection.

Entry requirement for the Construction and Maintenance specialty of this branch is a Bachelor's degree in pure or applied science. For the Fire Protection division, senior matriculation, the equivalent or higher, combined with five years' experience (full-time duty) in fire prevention activities in either a municipal, industrial or other recognized fire prevention organization is needed for entry.



Diesel power plant at an R.C.A.F. radar station, providing heat and power for the operations centre, is part of the equipment under the construction engineering branch. *(National Defence Photo)*

Mobile Equipment Engineering

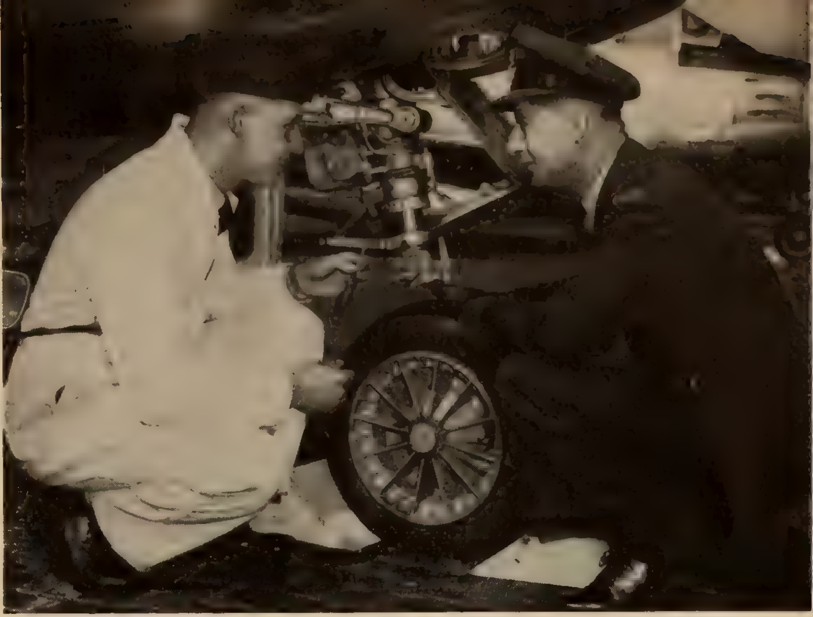
This branch is responsible for the operation and maintenance of mobile land and marine craft, and the administration of RCAF road transport services. Officers of this branch advise on equipment selection and employment, prepare specifications and cost estimates for equipment procurement and maintenance, conduct accident prevention studies and give technical advice in accident investigations involving mobile equipment, and provide technical training. They are also responsible for the management of unit mobile equipment organizations which involves the administration of road transport services and the inspection, repair, modification, salvage, reconditioning and preservation of mobile equipment and marine craft.

Telecommunications

The Telecommunications Branch of the RCAF involves the installation and maintenance of RCAF telecommunications equipment and the operation of surface communication facilities. Officers of this branch participate in the functions of policy and programme formulation, preparation of equipment specifications, estimation of requirements, advising on the use and development of telecommunications facilities, design and development, provision of trade training and management of telecommunications organizations. It involves immediate supervisory and technical responsibility for the operation of service communication facilities as well as the installation, servicing, inspection, modification, salvaging and preservation of communications and radar equipment.

Officers may be employed in assignments for which special qualifications are required. Included in these are: Radar (Ground Search), Communications Operation, Electronic Counter-Measures.

An aeronautical engineer discusses a maintenance point with an aero-engine technician beside the nose wheel of an R.C.A.F. F86 Sabrejet at Volkel, Holland, before the Fifth International Air Show, Ypenburg.
(National Defence Photo)



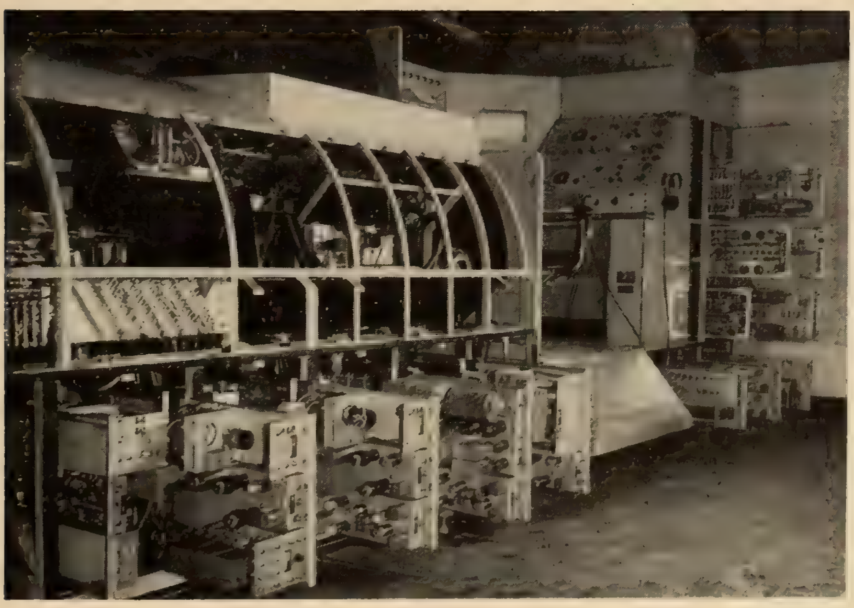
Photography

Duties of the Photography Branch cover the installation, operation and maintenance of RCAF photographic equipment. Officers of this branch participate in planning air photography operations, formulate photography policies, programmes and procedures, prepare specifications and standards for photographic procedures and equipment and provide technical training. They also assume responsibility for still and moving picture photography, photographic production, materiel maintenance and the test and development of photographic processes and material.

CONDITIONS OF ENTRY

An engineering graduate, interested in an Air Force career, may apply at any of the 22 RCAF Recruiting Units across Canada or write directly to Air Force Headquarters, Ottawa. Successful candidates are posted to Officers' School at London, Ontario, for a nine-week course of basic officer training. Upon graduation from this course they are commissioned in the rank of Pilot Officer. The first year is devoted to specialized training after which the officer is promoted to the rank of Flying Officer. The RCAF may supplement basic professional qualifications by sending the officer for special courses in the United States or United Kingdom and post-graduate courses are arranged at universities in the United States and Canada. Many officers have attained a Master's degree in various sciences and some have obtained their Ph.D.

The maintenance, servicing and repair of such complicated equipment as this jet flight-simulator is the joint responsibility of the aeronautical engineering officer and the telecommunications officer. *(National Defence Photo)*



Undergraduates

The University Reserve Training Plan (URTP) allows selected undergraduates to be enrolled for training with the RCAF during their university years. In this way, as Flight Cadets, they receive training in the form of two-hour-a-week lectures during the academic year and officer training, engineering training, and employment at an RCAF station during the summer months. Upon graduation they may join the Reserve or enter the Regular Force as Flying Officers.

University undergraduates may also apply for subsidization through their four years of college under the Regular Officers' Training Plan (ROTP). Under this plan, students receive their lodging, books and tuition fees and an allowance of $55 per month. These cadets may attend one of the Canadian service colleges or a Canadian university. In the latter case, an additional allowance of $65 per month is granted in lieu of lodging. Uniforms are issued free of charge.

The ROTP cadet may also be granted a subsidization for a further year of study after graduation from the service college so that he may obtain his degree. On graduation, he is granted a permanent commission as a Flying Officer in the RCAF branch in which he has received his training. He has also the option of release after three years' service.

CAREER OPPORTUNITIES

Once the officer in the Regular Force has completed his basic training and other training courses, he will normally be posted to a unit in the field. The aim at this time is to permit him to consolidate and apply the extensive training undertaken at the University and in the RCAF. He may be charged with the supervision of many men and much complex equipment, including aircraft. Within his own sphere of responsibility he has great scope for exercising his personal initiative and ingenuity. He learns to be part of a highly effective team, including aircrew, groundcrew, and specialist personnel.

In the RCAF there is such a wide variety of employment for the engineer, that during his career he will be called upon to exercise his abilities in many areas. The manner in which he applies himself and handles his subordinates determines his rate of promotion. As he gains experience, he progresses to more responsible positions and receives recognition in accordance with his demonstrated ability.

MONTHLY RATES OF PAY

Monthly rates of pay are shown in the accompanying table.

An officer also receives an allowance of $375 for his uniform when he first enters the RCAF. He will receive substantial pension benefits, free medical and dental care and a $5,000 insurance policy for $2.00 per month as well as other fringe benefits.

Monthly Rates of Pay

Rank	Basic Pay	After 3 Years in Rank	After 6 Years in Rank	After 9 Years in Rank	*Marriage Allowance	†Subsistence Allowance (S) Single (M) Married	Total
Pilot Officer or Flight Cadet	$185	...	...	....	....	$65 (S)	$250
					$40	$91 (M)	$316
Flying Officer	$230	.	...	...	....	$89 (S)	$319
					$40	$110 (M)	$380
	....	$245	...	....	....	$89 (S)	$334
					$40	$110 (M)	$395
			$260	..	....	$89 (S)	$349
					$40	$110 (M)	$410
Flight Lieutenant	$290	...	....	...	...	$94 (S)	$384
					$40	$110 (M)	$440
		$315	..	...	..	$94 (S)	$409
					$40	$110 (M)	$465
			$340	...	...	$94 (S)	$434
					$40	$110 (M)	$490
				$365	.	$94 (S)	$459
					$40	$110 (M)	$515
Squadron Leader	$370	.	...	....	....	$113 (S)	$483
					$40	(M)	$523
		$395	....	..	.	$113 (S)	$508
					$40	(M)	$548
			$420	....	....	$113 (S)	$533
					$40	(M)	$573
Wing Commander	$460	...	...	. .	....	$126 (S)	$586
					$40	(M)	$626
		$495	.	....	....	$126 (S)	$621
					$40	(M)	$661
			$530	...	....	$126 (S)	$656
					$40	(M)	$696
Group Captain	$615	.	..		....	$139 (S)	$754
					$40	(M)	$794
		$650	.	...	....	$139 (S)	$789
					$40	(M)	$829
			$685	....	....	$139 (S)	$824
					$40	(M)	$864
Air Commodore	$827	.	....	....	....	(S)	$980
					$40	(M)	$1020

* An officer eligible for marriage allowance receives $40 per month if living off the unit and $30 per month if occupying Government married quarters.

† Subsistence allowance is provided when rations and quarters are not available.

FUTURE OUTLOOK

As Canadian military aviation continues its rapid progress, the need for greater numbers of highly qualified engineers increases. According to Secretary of Defence Wilson, "half of the scientists and engineers [in the United States] work directly or indirectly for the defense effort." Although a similar statement cannot yet be made for Canada, RCAF experience alone underlines the growing need for engineers that is developing throughout the Department of National Defence.

Each of the technical branches of the RCAF has its own requirements and areas of responsibility, but they are interdependent. Each officer becomes a specialist in his own branch but he is expected to have a working knowledge of the activities of other branches and an appreciation of their problems. Only in this way can the branches work together as an effective team. Policy planning demands co-ordination within the branch and with those concerned in other branches. The planning must be integrated with specifications of aircraft design and development of new and better weapons and modern electronic devices to be installed in the aircraft. Management of projects involved in the construction of runways, hangars, control towers and personnel housing is closely allied with the operations of the Mobile Equipment Engineering Branch which provides the tractors, bull-dozers, cranes and trucks as well as general transportation vehicles. There must be a constant interchange of ideas between the officers of these various branches. Only by this close integration can an effective fighting system be developed and the maintenance of that system be kept at peak operating efficiency.

A primary factor of modern military superiority is technology. At this time when aviation is on the threshold of vertical flight, atomic powered aircraft and space travel, the scope for engineers in the service is particularly challenging.

A career in the RCAF is interesting and rewarding for a graduate engineer. Apart from its professional advantages, there is the personal satisfaction of service with a team designed for the maintenance of peace and the security of the people of Canada. √

Employment Service

THIS SERVICE is operated for the benefit of members of The Engineering Institute of Canada and for industrial and other organizations employing technically trained men—without charge to either party. It would be appreciated if employers would make the fullest use of these facilities to list their requirements—existing or estimated.

NOTICES appearing in the SITUATIONS WANTED column will be discontinued after three insertions. They will be reinstated, on request, after a lapse of one month.

REPLIES to advertisements should be addressed to File No. 000, Employment Service, The Engineering Institute of Canada, 2050 Mansfield Street.

INTERVIEWS with the Institute Employment Service, 2050 Mansfield Street, Montreal—Telephone PLateau 5078—may be arranged by appointment.

SITUATIONS WANTED

CHEMICAL ENGINEER, M.E.I.C., age 35, married. Ten years experience in research, development, control and production in the pulp and paper industry. Seeks senior supervisory or administrative position. Complete resume upon request. File No. 660-W.

EXECUTIVE ENGINEER, M.E.I.C., P.Eng. (Quebec), B.Sc., Queen's. With electrical and mechanical background and strong management and administrative experience desires change and seeks a senior and challenging appointment where his abilities can be fully used. Married with three children, and speaks and writes French. Full details of past experience and positions will be furnished to serious inquirers upon request. File No. 937-W.

GRADUATE ENGINEER, M.E.I.C., P.Eng. (Que.), McGill, substantial background manufacturing operations, plant organization and administration. Plant and project engineering. Layout, methods studies, standard costs, production control, material handling. Some sales. Age: mid-forties. Available reasonable notice. Seeks opening as production executive or assistant. Plant engineer or sales. Resume on request. File No. 1186-W.

CHEMICAL ENGINEER, B.Sc., (Ch.E.) M.E.I.C., M.A.I.Ch.E., 43, married, Canadian and U.S. resident; equal knowledge of English and German. Experience: 9 years research and development in fuel technology, 5 years process and project engineer in petroleum refinery engineering. Desires assignment in Germany, Austria or Holland as process, project, or sales engineer in the field of petroleum refinery engineering. Presently employed. Available on one month's notice minimum. File No. 1314-W.

MUNICIPAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), Queen's (Civil) 1949. Age 33, single, with 6½ years municipal experience including 2½ years as Town Engineer in Ontario town of 8,000 population, seeks an opening in municipal or allied field with future and responsibility. Available in 1956 on one month's notice to present employer. Anywhere in Canada. File No. 4012-W.

ELECTRICAL ENGINEER, B.Eng. (Hons.), M.A.Sc., M.E.I.C., P.Eng., age 37, married, and presently completing tenth year as a professor of electrical engineering. Most of teaching has been on advanced level with emphasis on power. Broad general experience in construction, public utility engineering and as a naval officer. Has done considerable consulting work of a general nature. Seeks appointment conducive to personal and professional growth. File No. 4402-W.

CIVIL ENGINEER, Jr.E.I.C., Sask., 1949, married, age 27. Desirous of employment in Alberta. Experience chiefly in the field of heavy industrial equipment. Would like sales, plant engineering, application engineering. Presently located in Montreal. File No. 4517-W.

POWER ENGINEER. Born U.K., B.Sc. (Eng.), 1947, P.Eng. Works trained—2 years experience electrical distribution; 3 years transmission design and construction; 3 years power house design and construction. Last two years spent in Canada with consulting engineers as, resident electrical engineer on 80,000 H.P. hydro electric project and as a design engineer. Seeks responsible post with management prospects or as senior development engineer. Preferred location Montreal. File No. 4803-W.

GRADUATE MECHANICAL ENGINEER (McGill), age 34. 7 years of design and draughting experience in hydraulic turbine design, process and steam piping, plant layout, sheet metal work and materials handling seeks draughting or design work night and/or on weekends. Also translation of German scientific papers into English. File No. 4809-W.

MECHANICAL ENGINEER, M.E.I.C., age 39, married. Fifteen years valuable experience in designing, estimating, selling and project engineering in the machinery and plate industry. Desires position in the Montreal area with reliable firm and good future. Presently employed, but available upon reasonable notice. File No. 4814-W.

MECHANICAL ENGINEER, P.Eng., M.E.I.C., A.M.I., MechE. First class B.O.T. Steam & Diesel certificate. 32 years old, married, no children. Desires responsible position in mechanical or marine engineering fields. Experience consists of five-year workshop apprenticeship, seven years as marine engineer officer and one year surveyor to international classification society in United Kingdom. Canadian experience includes one year experimental thermodynamics, two years in charge engineering department large insurance company. Available on reasonable notice to present employer. File No. 4815-W.

CIVIL ENGINEER, Jr.E.I.C., (U.N.B. 1950), married. Age 29. Experience construction and maintenance. 5 years experience with large transportation company. Familiar sewage and drainage problems. Interested in municipal engineering or contracting. Fluently bilingual. Available on two weeks notice, for work in Quebec or Ontario. Expected salary open for discussion. File No. 4818-W.

MECHANICAL ENGINEER, Jr.E.I.C., 1952 B.Eng., married, age 34. Completed training course with large manufacturer of electrical equipment. Presently employed; experience includes cost reduction and product improvement work as manufacturing engineer on switchgear equipment, induction and synchronous motors. Varied experience in sales and field engineering. Capable public speaker. Desires sales or product engineers' position demanding initiative and with opportunity for advancement. Preferred location in Ontario or Maritime Provinces. File No. 4820-W.

PROFESSIONAL ENGINEER, B.A.Sc. Electrical 1953, S.E.I.C., 27 years old, married, two children. Fluently bilingual. 2½ years extensive design and supervision work with consulting engineering firm. Other diversified experience as resident engineer on construction project. Capable of dealing with people at any levels. Would consider position where initiative, ability and productivity is needed and which offers challenge and advancement. Location preferred: Eastern Ontario or Quebec. File No. 4830-W.

CHEMICAL ENGINEER, Jr.E.I.C., B.Eng., McGill, 1952, A.I.Ch.E., Jr.E.I.C., C.I.C., P.Eng., age 28, married, desires a more responsible position. Experience in development work in chemical plant and paper mill. Also administrative experience as production supervisor in a chemical plant. Presently employed in Quebec, however would consider employment anywhere in production supervision or development. File No. 4832-W.

CREATIVE ENGINEER, supervisory and management background in chemical and process metallurgy fields, and with sound engineering understanding. B.A.Sc. (Toronto), M.Sc. (Queen's), and A.H.I. business course. M.E.I.C., age 34. Can contribute in plant management, operational analysis or technical administration. File No. 4833-W.

HYDRAULIC ENGINEER, M.E.I.C., Junior member A.S.C.E., graduate B.Sc. (C.E.) Man. 1948, M.Sc. Utah State 1955, married, 31, two children. Returning to Canada desires employment in hydraulic design or related fields, 6½ years experience in drainage, irrigation and highways. File No. 4834-W.

GRADUATE ENGINEER, economist, accountant, 33, experience in construction, cost and production control, management, Government, and commerce in the Far East, requires senior executive or advisory appointment in Ontario, Quebec or Foreign. File No. 4835-W.

ENGINEERING AND BUSINESS GRADUATE, P.Eng., Jr.E.I.C., U. of Toronto 1952, married, age 26. Will receive M.B.A. from University of Western Ontario, May 1956. Business experience includes: 15 months as a production control project coordinator (dealing with all departments) with a large electronic equipment manufacturer; 1 year as a placement supervisor for professional and technical personnel with a large aircraft firm. Desires definite assignment or training course in some aspect of manufacturing (preferably production planning and control) which will ultimately lead to a position of responsibility. Available May, 1956. Full resume and references upon request. File No. 4837-W.

ELECTRICAL ENGINEER, B.Sc. 1953, Queen's University, Jr.E.I.C., P.Eng., (Ontario). Age 24, single. 2½ years in England on a graduate training course with a large manufacturer of power equipment, which includes 1½ years on the design and development of air-break switchgear and some experience in the short circuit testing of air-break switchgear, would like employment which would lead to a position of responsibility in Canada or abroad. File No. 4838-W.

MECHANICAL ENGINEER, age 30, married. M.E.I.C., A.M.I.E.E., A.M.I., Mech.E., A.M.C.T. Qualified in both mechanical and electrical engineering. Seeks responsible position requiring wide general engineering experience and with prospects of advancement. Diversified engineering training. Twelve years experience in Public Utility power stations. Six years as mechanical project engineer with Canadian Consultants on design and operation of thermal power stations and allied industrial installations. File No. 4839-W.

A GRADUATE OF THE University of Manitoba, 1951, in electrical engineering, Jr.E.I.C., 31 years of age, married. Since graduation has been employed by a major oil company in their seismic oil program. Has had experience in all phases of field work. At present is field supervisor in charge of operations, production and supervision of field personnel. Would prefer a position of a less nomadic nature in a western province. File No. 4840-W.

ELECTRICAL ENGINEER, 28, married. 1954 graduate (Edinburgh), Jr.E.I.C., desires position with power utility or engineering firm. 1½ years experience telecommunications, 3 months power distribution. Available April 1st, 1956. Location: Ontario or Montreal. File No. 4841-W.

MECHANICAL ENGINEER, S.E.I.C., B.Sc., Manitoba 1954, Athlone Fellow, will obtain M.Sc., Engineering production at University of Birmingham, England, 1956. Return to Canada August or September, 1956. Age 24. Experience: summer 15 months RCAF, aeronautical Engineer; summer 9 months pulp and paper mill maintenance in Quebec Province; 12 months large turbo-electric equipment manufacturer (England). Extensive industrial visit program throughout England, in present year, with emphasis on management consultation. Present studies include: business organization, production planning and control, plant layout, work, study, industrial statistics, cost accounting. Desire position to make use of training. Locate anywhere in Canada. File No. 4842-W.

GRADUATE CIVIL ENGINEER, M.E.I.C., P.Eng., Member of Royal Institute of Engineers (Holland), age 28. Experience in hydraulic and hydrologic engineering studies and general construction work, seeks position which bears responsibility, preferably with a medium sized construction company or consulting firm. File No. 4843-W.

CIVIL ENGINEER, M.E.I.C., graduate Pol. Tech. 1944, P.Eng. (Que.). Seeks employment with consultant or general contractor. Experience includes field engineering, concrete design, municipal works. Presently located in Montreal. File No. 4844-W.

MECHANICAL DESIGN ENGINEER, aged 42, wishes to relocate in Ontario. Excellent record in creative product design. Seeks position where experience and inventiveness in this field can be used. Positions held include administration. File No. 4845-W.

ATHLONE FELLOW, 26, married, B.A.Sc. and M.A.Sc. in engineering physics from University of British Columbia 1952 and 53, returning to Canada in summer of 1956. Two years spent on heavy current training scheme at British Thomson-Houston Co., Rugby, England, plus some additional academic and engineering work on power system studies. Seeks interesting work anywhere. File No. 4846-W.

MECHANICAL ENGINEER, Jr.E.I.C., P.Eng. (Ont.), B.Sc. Queen's 51, married, age 27. 3 years varied experience in industrial equipment, including two year Allis-Chalmers training course, engineering, service and sales. Interested in plant engineering, application and sales, or position offering variety of work. Desire responsibility. Details on request. File No. 4847-W.

MECHANICAL-ELECTRICAL ENGINEER, M.E.I.C. with B.E. in mechanical engineering, N.S.T.C. 1947, age 30, married with family. C.G.E. test course, 7 years experience with utility in substation design and estimating, specification writing for switchgear and construction supervision. Seeking position with electric utility, electrical contractor, consulting firm or in plant maintenance. Available immediately. Location open. File No. 4848-W.

EXECUTIVE ENGINEER AND SALES manager, M.E.I.C., with 20 years experience in sales engineering and administration for large nationally known electric manufacturing company, P.Eng. (Alberta), available January. Canadian, graduate, married, willing to locate anywhere in Canada. Many years experience in B.C., at present in Edmonton. Have extensive knowledge of mining, pulp, paper and lumber, chemical and general industrial requirements. File No. 4849-W.

SITUATIONS VACANT

CHEMICAL

CHEMICAL ENGINEERS, required by chemical works within 40 miles of Montreal. Successful applicants will be trained for production supervision. Two years experience preferred. File No. 5352-V.

CHEMICAL ENGINEER required by newsprint mill in P.Q. A graduate chemical engineer from recognized university with some experience in the pulp and paper industry is required for the technical department. Work will consist of technical investigations of various plant operations, improved process control and paper quality. Excellent opportunity for rapid advancement. Salary dependent on experience and ability. House available. Initial letter to include full resume of experience. File No. 5453-V.

CHEMICAL ENGINEERS (3 years or less experience) required for research and development work in large chemical company situated in Niagara Falls, Ontario. File No. 5380-V.

ALUMINUM COMPANY OF CANADA LTD. has openings for graduate engineers particularly in the fields of chemical engineering and extractive metallurgy. For production or development in their plants in the Saguenay district, Quebec and Kitimat, British Columbia. File No. 5467-V.

RECENT GRADUATE CHEMICAL ENGINEER REQUIRED by paper company in Province of Quebec. Interviews arranged in Montreal. File No. 5484-V.

CHEMICAL ENGINEERS and chemists required for process control and research work in a New Brunswick company's pulp mills. Apply giving full particulars and salary expected. File No. 5495-V.

CHEMICAL ENGINEER with 4 to 5 years experience required for new chemical plant to be located near Montreal by large and well known industrial concern. Excellent opportunity for a young man wishing to get in on the ground floor of a new and substantial chemical operation. Salary open. File No. 5498-V.

CHEMICAL ENGINEER required by chemical and polyethylene plant 75 miles from Toronto. Prefer recent graduate with 1 to 3 years experience. Must have qualifications for production supervisory position. Good possibilities for advancement in a growing industry. Apply File No. 5503-V.

CHEMIST WANTED TO work on analysis research and development of lubricating oils and greases, metal cutting fluids and soluble oils. Education level B.Sc. or B.A. minimum with knowledge of quantitative chemical analysis. Petroleum experience desirable, but not necessary. Salary range $322 to $458 per month, commensurate with previous experience. Location of employment, Montreal. File No. 5526-V.

VACANCIES EXIST IN a large specialty pulp and paper mill in the Eastern Townships, Province of Québec. We require one chemical engineer and one chemist. The successful applicants will be employed in the technical department. Initially work will consist of technical investigations throughout the mill aimed at increased production and higher quality. The positions offer interesting work with good opportunities for advancement. Candidates must be recent graduates of a recognized university. Previous experience in the industry is not necessary. Essential qualities are initiative, self-confidence and ability to work with a minimum of supervision. Apply in writing gving full details of education, experience and career. Naturally all applications will be handled in strict confidence. File No. 5539-V.

CIVIL

SENIOR PROJECT ENGINEER required by young municipal engineering firm to supervise both design and construction of complete water supply and sewage disposal system. Qualifications thirty to forty years with applicable experience in Canada. Please reply giving full details of academic training, professional experience, references and salary requirement. File No. 5332-V.

RECENT GRADUATE CIVIL engineer required in the track section of the office of the chief engineer of a major railway company in Montreal. File No. 5377-V.

CIVIL ENGINEER preferably not over 35 years of age required by structural steel firm in Montreal, to act as salesman for roof deck and wall panel construction. Salary open. Please reply File No. 5393-V.

GRADUATE CIVIL ENGINEERS required by well known engineering and construction company for specialized work in the field of soil mechanics and foundation engineering. Post graduate studies in soil mechanics and structures desirable but not essential. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5391-V.

SOILS ENGINEERS required by well known engineering and construction company. Must be graduate civil engineers, preferably with post graduate studies in soil mechanics and foundation engineering. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

ENGINEERING GEOLOGIST required by well known company specializing in the field of soil mechanics foundation engineering and geotechnical processes. Must have post graduate studies in Pleistocene and be interested in the application of geologic aspects to civil engineering works. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5396-V.

PROJECT ENGINEER, excellent opening for the right man, with a well established engineering firm in Montreal specializing in the hydro electric field, this is a senior position. Applicant should be a graduate with 15-20 years experience in the design, preparation of plans and specifications, reports and estimates for the civil engineering aspects of hydro electric power developments. He will be required to take charge of a designing group as project engineer. The position is of a permanent nature and entails the usual pension, group insurance and other benefits. The salary will be commensurate with the capabilities, educational background and experience of the applicant. The applicant should be prepared to furnish references as to his qualifications and experience. All applications will be acknowledged. File No. 5431-V.

CIVIL ENGINEER with good knowledge of building construction and costing by general contractor in the Kingston, Ontario, area. Salary open. File No. 5434-V.

STRUCTURAL ENGINEER with some experience in steel or reinforced concrete. Age to 35. Applicants must be willing to headquarter in Minniapolis, Minnesota, with some travel in both the U.S. and Canada. Position offers permanence and opportunity for advancement. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

CONSTRUCTION ENGINEER for company located in Western Canada. Age range 40-50. Must be well experienced in asphalt paving, soils, road work, concrete structures, gravel plants. Must be able to operate as general superintendent. Excellent salary and possibility of participating in company profits. File No. 5437-V.

STRUCTURAL STEEL DESIGN and detail engineers required by a progressive pulp, paper and converting company. The location is in Eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

ADMINISTRATIVE OPPORTUNITY

A nation-wide manufacturing and sales organization has an opening for an administrative assistant to the works manager in a plant which features a mechanized production foundry. A mechanical engineering graduate is preferred for this position which offers excellent opportunities for advancement. Applicants should have considerable supervisory experience and a good working knowledge of standard and incentive plans, together with a keen appreciation of cost work. Reply in confidence giving full particulars. File No. 5550-V.

TO THE YOUNG ENGINEER

A Chance to Perform

IN THE SERVICE OF CANADA

Today an army runs on powered wheels and muzzle velocity, cosine and stress, vanishing point and point of no return, logistics and stamina level, absolute zero and the cathode ray.

To be on top, an army must have the talents of men who can design, prove and service the machines and instruments that will keep it there.

Engineers — civil, chemical, electrical, mechanical — help keep an army functioning smoothly.

Therefore the Army can use young imaginative engineers, engineers who, in the interest of keeping the Canadian Army ahead, will be encouraged to pursue their special talents.

Request an interview with the Recruiting Officer nearest you. Ask him about careers for officers in the Engineering branches of the Army. He has the answers you need, or write:

Directorate of Manning,
Army Headquarters, Ottawa, Ont.

SANITARY ENGINEER wanted for Department of Health, Newfoundland. Applicant must have a degree in civil engineering and/either a certificate in Public Health Engineering or be willing to take a year's training in public health on a bursary supplied by the Department. Enquiries re salary and conditions of employment to be directed to File No. 5442-V.

CIVIL ENGINEER recent graduate required as assistant to City engineer. Experience in asphalt paving desirable but not essential. Salary dependent on experience. Applications close December 15, 1955. Additional information will be supplied, upon request. Apply to city engineer's office, City Hall, Swift Current, Sask. File No. 5469-V.

CIVIL ENGINEER required by construction company located in Maritime Province. Applicant should have building construction experience and would be required to completely organize and supervise all phases of the office work and carry out liaison with the superintendent and all sub traders in the field. A speaking knowledge of French would be helpful but not essential. Position offers permanency and a good opportunity for an engineer with building construction background who would like to go to Maritimes and take complete charge of a growing construction company. File No. 5470-V.

SEVERAL POSITIONS AVAILABLE for graduates in engineering or architecture, preferably in city planning for the City of Ottawa, Department of Planning and Works. Duties will consist of general planning studies with particular reference to zoning and land subdivision. Salaries to be negotiated. File No. 5471-V.

ENGINEERS REQUIRED BY the Saskatchewan Department of Agriculture. Salary range $337 to $409 per month. Requirements, university graduation in engineering with some professional or sub professional experience. Civil or agricultural engineers are preferred. Duties: project engineers for irrigation, drainage and flood control work to do preliminary investigation, and supervise the operation and maintenance program. The work is under the general direction of a district engineer. Benefits: 3 weeks holidays and 3 weeks sick leave per year; generous pension plan. These positions offer an excellent opportunity to obtain on the job training in this specialized field. File No. 5472-V.

CIVIL ENGINEER required to act as engineering assistant in the City Engineer's office, London, Ontario. The starting salary is $3,604.00 increasing $200.00 per year to $5,088.00. File No. 5474-V.

DESIGN ENGINEERS wanted by a rapidly expanding firm specializing in prestressed and precast concrete throughout Canada. Several years experience in reinforced concrete is required. Positions offer salary, participation in company's hospitalization and pension plans. File No. 5477-V.

ESTIMATOR EXPERIENCED in industrial buildings, bridges and heavy construction required by expanding firm operating throughout Canada. Position offers salary participation in company's hospitalization and pension plans. Applicants should give full details, including age, education and background, experience, marital status, salary requirements. File No. 5477-V.

SALES ENGINEER for promotion and sales in professional field with background in structures and construction required by firm specializing in prestressed and precast concrete throughout Canada. Position offers salary and commission, participation in company's hospitalization and pension plans. Applicants should give full details including age, education and background, experience, marital status, salary requirements. File No. 5477-V.

FOREST AND CIVIL ENGINEERS required by established consultants with headquarters in Western Canada. Qualifications: 2 to 8 years experience, able and willing to assume responsibility for and be capable of managing projects which include timber management, forest surveys, appraisals and evaluations, logging inspection, design and supervision of construction, etc. Salaries: commensurate with experience and qualifications. Advancement: excellent opportunity exists for advancement in a rapid expanding organization. Please submit full details of qualifications, experience, references, etc. File No. 5480-V.

WANTED FIELD ENGINEERS with 2 to 8 years experience in major civil engineering and structural work, to work on varied projects in Eastern Canada from Montreal office. Must be accurate instrument men and for senior positions capable of supervising contractors work. Some knowledge of piling and dock work a decided advantage. Minimum of several years work for right man. Application sent to File No. 5483-V.

CONSTRUCTION ENGINEER wanted to fill position of projects manager for large general contractor located in Nova Scotia. Experience should include housing development and general construction. Applicant must have had field experience and be able to take charge of estimating. This is a senior position with excellent income opportunities. Reply stating age, education, experience and salary required to File No. 5496-V.

CONSULTING ENGINEER has opening for structural engineer with minimum 10 years experience in commercial work. An associateship will be offered to a suitable man. All replies treated confidentially. File No. 5501-V.

GRADUATE CIVIL ENGINEERS for field work, required by international engineering and construction company specializing in petroleum and chemical fields. Preferably experienced in concrete foundations; erection structural steel; detailing, fabrication and erection of piping. Non-experienced applicants will be considered. Send resume of qualifications and experience. Replies will be treated confidentially. File No. 5512-V.

CIVIL ENGINEER, required by firm of consulting engineers located in Northern Ontario. Applicant should have experience in design and construction of waterworks, sewers, roads, sidewalks and related municipal engineering services. File No. 5513-V.

CIVIL ENGINEER required by City of Westmount. Prominent position for opportunity to acquire general experience in municipal work. File No. 5530-V.

CANADIAN CONSULTING FIRM with outstanding reputation in civil and structural engineering requires assistant design engineers. Requirements: university graduates with high academic standing. 2-3 years experience in reinforced concrete and structural steel. Experience in foundation work and prestressed concrete desirable, but not essential. Field engineers, requirements: university graduates with some experience in surveying. 3-4 years field experience in civil engineering construction. Experience in heavy foundation work desirable. Draughtsman with thorough knowledge of reinforced concrete detailing. Applicants should reply stating age, experience, previous salary and academic record. Only those interested in permanent position need apply. File No. 5531-V.

ASSISTANT HYDRAULIC ENGINEER. An assistant hydraulic engineer is required immediately by the Fraser River Board for office studies in connection with flood control and water power development planning. Location: Victoria, B.C. Salary commensurate with experience and ability in the range $4,000 to $4,500 per annum. Qualifications Civil engineering degree from a university or equivalent. A knowledge of hydraulics and its application to river development problems is important. Applications should be addressed to the executive assistant Fraser River Board, 302 Belmont Building, Victoria, B.C. File No. 5535-V.

APPLICATIONS ARE INVITED from graduate civil engineers for the position of assistant engineers with the City of Moncton, N.B. Present population is approximately 40,000. Two vacancies exist, one for a graduate with five or six years experience, preferably in the municipal field. One for a graduate recently qualified. Written applications to City Engineer, Moncton, N.B., with details of training, qualifications, experience, age, marital status, war service, references and approximate salary required. Closing date February 24, 1956. File No. 5541-V.

GRADUATE CIVIL ENGINEER required for the position of assistant roadways engineer. Applicant should have two or more years of experience. Applicants are requested to submit full details of education, experience, age, marital status, salary expected, references, when available, recent photograph. Applications will be received by the undersigned until February 1, 1956. File No. 5542-V.

ASSISTANT TOWN ENGINEER required in Ontario. Graduate with 2 to 4 years experience and with some construction experience. Municipal experience is preferred but not essential. Work involved is the supervision of surveys and the inspection and control of various municipal engineering projects. Salary open. File No. 5547-V.

MUNICIPAL ENGINEERING FIRM requires civil engineer with extensive experience in design and construction of all phases of waterworks, sewerage and sewage disposal systems. Only persons of unquestionable

ENGINEERS

TORONTO MANUFACTURER OF FUEL CONTROL SYSTEMS FOR AIRCRAFT GAS TURBINE ENGINES HAS OPENINGS IN THE FOLLOWING FIELDS:

ELECTRONICS ENGINEER

Graduate electronic engineer experienced in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of independent work on servo-mechanisms for aircraft application.

PERFORMANCE ENGINEER

With a degree in engineering or science and a strong mathematical background. A knowledge of hydraulics and aerodynamics essential. Experience in servo-mechanism controls most desirable.

DEVELOPMENT ENGINEERS

Graduate mechanical engineers preferably with a background of experience in aircraft hydraulics. Experience in servo-mechanism controls an asset.

APPLY WITH FULL PARTICULARS INDICATING SALARY REQUIREMENTS TO EMPLOYMENT OFFICER, P.O. BOX 115, STATION H, TORONTO 13

LUCAS-ROTAX LIMITED

Applications are Invited for the Position of

CITY ENGINEER

of

THE CITY OF LANCASTER,

New Brunswick

Applicants must be experienced qualified civil engineers.

When submitting applications please give previous experience and salary expected.

D. H. Garey,
City Clerk,
City of Lancaster, N.B.

competence need apply. Please give full details of academic training, professional experience, references and salary requirements. File No. 5553-V.

ELECTRICAL

GRADUATE ELECTRICAL ENGINEER, required as assistant engineer in rural department of power company in Alberta. Location in Edmonton. Duties involve design and estimation of single phase farm power lines with related engineering. Salary commensurate with qualifications. Excellent employee benefits provide pension, group life, sickness and accident coverage. File No. 5359-V.

TWO JUNIOR ELECTRICAL or engineering physicists for work in our research and development departments. The work involves research and development work in various special antennae and related components. Location: Ontario. File No. 5374-V.

ELECTRICAL MANUFACTURING ENGINEER with experience in the design and manufacture of air break switch gear required for chief engineers position with Western manufacturer. Should be capable of leading a development program in a newly equipped lab on low voltage air break switchgear and circuit breakers up to 15 KV. Salary open. Replies from applicants with all or part of the required experience will be treated in strict confidence, and should contain full details of experience, age, and educational background. File No. 5395-V.

COMMUNICATIONS DEPARTMENT of large transportation company in Montreal has immediate openings for electrical engineering graduates specializing in or with experience in communications as assistant engineers in the transmission and equipment groups. Work involves application and special engineering of all types of carrier telephone, telegraph, program network transmission, television and broad band microwave systems. Offers wide range of experience in communications field. Headquarters Montreal, with field engineering throughout system. All replies will be held in strict confidence and will be acknowledged. File No. 5403-V.

ELECTRICAL ENGINEER with experience in design of electrical installation including communications for industrial and commercial buildings. Minimum five years experience since graduation. Firm of consulting engineers in Toronto. File No. 5411-V.

ELECTRONIC ENGINEER, required with several years experience in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of independent work on servomechanisms for aircraft application. Manufacturer of aircraft engine fuel systems located in Toronto. Apply with full details as to age, date of graduation, experience and approximate salary required. File No. 5412-V.

APPLICATIONS ARE INVITED FROM electronic development engineers with experience in the intermediate frequency field, for advanced development work associated with I.F. circuits and systems for new techniques in pulse and doppler radar. The position, which is permanent and pensionable, is at the company's main plant at Rugby, England. Qualifications: university degree and at least two years experience in I.F. or related circuit developments. Applications, stating age and giving details of qualifications, should be made in the first instance to File No. 5446-V.

MICROWAVE DEVELOPMENT ENGINEER. Applications are invited for the position of development engineer at the company's main plant, Rugby, England. The position is permanent and pensionable, and concerns long-term development of the latest techniques in microwave systems of unusual complexity. Ample opportunities are afforded for original work. Qualifications: university degree in electrical engineering or physics, and at least two years practical experience in microwave systems and/or components developments. Applications stating age and giving details of qualifications should be made in the first instance to File No. 5446-V.

OPPORTUNITIES FOR ELECTRICAL ENGINEERS and engineering physicists with the Defence Research Board at Valcartier, Quebec; Ottawa, Ontario; Dartmouth, Nova Scotia. The challenging program, which offers excellent chance for advancement, includes research on missile control systems, servo-mechanisms, temperature and vibration problems, fire control systems, instrumentation, low frequency and high frequency propagation, radio communication circuits, radar, microwave techniques, and underwater acoustics. Applications are invited from university graduates (or the equivalent) who are Canadian citizens or British subjects. Initial salaries range from $3,750.00 to $6,000.00 depending on qualifications and experience. Modern laboratory facilities and generous employment benefits available. File No. 5447-V.

ELECTRICAL ENGINEER required by Potash company in Saskatchewan. Must be qualified to lay out and supervise installation and maintenance of power distribution system for an industrial plant and mine. A knowledge of control systems, switchgear, relaying and heavy motors is desired. Position involves supervision of electrical and mechanical installation and offers a varied and interesting position in an expanding company. File No. 5448-V.

CITY OF MONCTON

APPLICATIONS ARE invited from graduate civil engineers for the position of Assistant Engineers with the City of Moncton, N.B. Present population is approximately 40,000. Two vacancies exist, one for a graduate with five or six years experience, preferably in the municipal field, one for a graduate recently qualified. Written applications to City Engineer, Moncton, N.B., with details of training, qualifications, experience, age, marital status, war service, references and approximate salary required. Closing date February 24, 1956.

ELECTRICAL ENGINEER, graduate two to five years experience, protective relay work with electric utility. Permanent position, long-established supervisory consulting organization. Headquarters New York. Some travel Latin America. Salary commensurate with experience. Reply stating age, education, experience, personal particulars and minimum salary expected. File No. 5450-V.

YOUNG ELECTRICAL ENGINEER, power option, recent graduate or man with one or two years experience. Good opportunity. Permanent position with long-established electric utility in Costa Rica. Knowledge Spanish necessary. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No. 5451-V.

GRADUATE ELECTRICAL ENGINEER, required to assist in preparation of plans, specifications and estimates of electrical systems for offices, shops and buildings designed in chief architect's department Trans-Canada Air Lines, Montreal. Preference given to applicants having two or more years general experience in the electrical branch of construction work and interested in being closely associated with architectural work. Permanent position with full employee benefits. File No. 5452-V.

SENIOR POWER TRANSFORMER design engineer. Good opening for aggressive man unafraid of responsibility and with existing or potential ability to handle up to the largest ratings. Well established firm with excellent technical facilities. Salary open and commensurate with experience and ability. Our employees know of this advertisement. All replies will be treated as confidential. File No. 5461-V.

SYNCHRONOUS MOTOR DESIGN ENGINEER, capable of all types of synchronous motor and generator design, and with experience in the design of hydro alternators, up to 10,000 KVA. Salary commensurate with experience and ability. Our employees know of this advertisement. All replies will be treated as confidential. File No. 5482-V.

TEST LABORATORY SUPERVISOR required by electrical appliance manufacturer in London, Ontario. Must have some industrial chemistry experience and supervisory potential if not experience. File No. 5489-V.

ELECTRICAL ENGINEER with 4 to 6 years experience. Duties include co-ordination of mine electrical installations, preparing plans, drawings and cost estimates of new installations and alterations to existing installations, surveys for substations and power lines as well as technical direction to electrical foreman and staff. Location, Atikokan, Ontario. Salary dependent on experience. File No. 5494-V.

PURCHASING AGENT. CHIEF PURCHASING agent required for manufacturer of large electrical apparatus, situated in the Niagara Peninsula. Duties consist of supervising and performing purchasing functions, including procurement and expediting of all raw materials, purchase parts, equipment, tools and supplies. File No. 5499-V.

ELECTRICAL ENGINEER—senior engineer required by major consulting firm located in Vancouver, B.C. Experience in pulp and paper mill power system development, installation, and operation required. Excellent opportunity for man with proper qualifications. Group benefits available. In reply please state experience, salary expected and availability. File No. 5510-V.

ELECTRICAL ENGINEER required by public utility with head office in Winnipeg. Starting salary $350 to $425 per month in accordance with qualifications. Must be graduate of recognized university with at least two years experience preferably with an electrical utility. File No. 5524-V.

ELECTRICAL ENGINEER, young, bilingual, preferably graduate C.G.E. test course required for sales engineering with old established Montreal firm. Hearquarters in Montreal. Replies treated confidentially. File No. 5528-V.

JUNIOR ELECTRICAL ENGINEERS, 5 graduates for power station and substation electrical design. Location N.Y. with established service organization for a large group of electrical utilities. Requirements 1 to 3 years with leading electrical equipment manufacturer, G.E. or Westinghouse test course, or actual electrical design operation construction experience on steam, diesel or hydro plants and substations. Limited foreign travel possibilities in future. Reply stating age, education, experience, personal particulars, and minimum salary expected. File No. 5534-V.

BILINGUAL GRADUATE electrical sales engineer required by well known company manufacturing low voltage electrical distribution

ASSISTANT PUBLIC HEALTH ENGINEER, B.C. Civil Service, DEPARTMENT OF HEALTH, VICTORIA, B.C.

Salary: $387.-$464. per month. Should be eligible for registration as a civil engineer in B.C., preferably post graduate degree in Public Health Engineering or able to take such training on a bursary supplied by Department. Must be British subjects; usual veterans' preference. Apply Chairman, Civil Service Commission, Victoria, British Columbia.

125 OPPORTUNITIES for CIVIL ENGINEERS

in various parts of Canada STARTING SALARIES UP TO $6,840

If your professional background includes experience in any of the following.

STRUCTURAL DESIGN

Buildings, Bridges, Towers, Dams (steel, concrete, timber, earth)

HYDRAULIC COMPUTATIONS

Relating to design of Penstocks, Spillways. Open Conduits and general channel improvements.

CONSTRUCTION AND/OR MAINTENANCE

Buildings, Bridges, Masts.
Sewage and Water Systems.
Dams, Jetties, Spillways, Canals.
Aids to Navigation.
Roads and Runways.

SITING AND SURVEYING

Roads and Airports. (Preliminary and Final).
Geodetic, Topographic, Hydrometric, Legal.

You will be interested in 125 challenging opportunities offering generous benefits, excellent working conditions and modern technical facilities with **THE CIVIL SERVICE OF CANADA**

***For complete details write to:* CIVIL SERVICE COMMISSION, OTTAWA, ONTARIO**

Ask for Information Circulars 56-1250 and 56-1250-1

and motor control equipment. Job offers a challenging opportunity to man with 2 to 5 years experience. Definite sales aptitude and a desire to get ahead. Excellent benefits. Location: Montreal. File No. 5538-V.

ELECTRICAL ENGINEER, university graduate required with minimum three years experience in transformer and coil design as applicable to communication equipment. Location Montreal, permanent position, salary open and commensurate with experience. Give details of age, experience and education. File No. 5549-V.

MECHANICAL

GRADUATE MECHANICAL ENGINEER required by a heavy industry with extensive mining and milling operations in the Eastern Townships (Quebec). Duties will include machine design, plant layout, work scheduling, etc. Preference will be given to applicant with one year's experience or recent graduates. Good opportunity, interesting and permanent position with attractive salary. Numerous employee benefits. Replies should include complete record of education, also salary expectation should be mentioned. File No. 5338-V.

MECHANICAL SALES ENGINEERING and application engineering positions in new and growing company making electrical, industrial control apparatus in S.W. Ontario. Prefer electrical mechanical or engineering and business 1955 grads. File No. 5388-V.

GRADUATE MECHANICAL ENGINEER for large industrial concern near Montreal required for development work and general project engineering. Permanent staff position and good prospects for promotion for young engineer with initiative and ability for original design work. Previous experience preferred but not necessary. We will pay travelling expenses for interview. Write stating personal information, experience in detail, salary required and date available. File No. 5390-V.

DESIGN ENGINEERS required for commercial vehicle design. Good opportunity with a sound future for a graduate mechanical engineer in structural design. Location: Ontario. File No. 5429-V.

MECHANICAL ENGINEER, either recent college graduate or with some experience. Age to thirty-five must be willing to locate in Minneapolis, Minnesota, and to travel as required by duties. Interests and/or background should be in air handling, plant layout or design. Position offers good salary, opportunity and permanence. Reply giving complete information regarding personal history, education and experience. File No. 5436-V.

WANTED MACHINE DESIGN ENGINEERS. A progressive pulp, paper and converting comany has opportunities for experienced pulp and paper mill machinery designers. The location is in eastern Canada. Excellent residential, educational and recreational facilities are available. Applications will be treated with strictest confidence. Send complete resume and salary expected to File No. 5439-V.

LARGE CHEMICAL PLANT IN Edmonton area has staff openings for two mechanical engineers. (1) Required qualifications and duties as follows: qualifications B.Sc. in mechanical engineering from recognized university. Up to 5 years experience in design on field work. Ability to supervise drafting work. Duties: general engineering in chemical plant including design and layout of alterations and new installations. Supervision of drafting work. (2) Qualifications: B.Sc. in mechanical engineering from recognized university. Up to 7 years' experience in design or field work. Experience in plant maintenance work an asset. Ability to supervise clerical and drafting work. Duties: maintenance engineering, including trouble shooting of mechanical problems, responsibility for spare parts program. Assist in setting up preventive program. Mechanical design work. Please supply references, age, marital status, academic standing, experience, salary expected and data available. File No. 5440-V.

SALES ENGINEER, age 25 to 30, mechanical engineer or equivalent required by well known Canadian heavy machinery manufacturer to handle pulp and paper mining and process industry accounts; to work out of Montreal; reply in writing stating age, education, experience, etc. File No. 5441-V.

INDUSTRIAL ENGINEER. An attractive position for an ambitious man about 35 years of age has developed in our industrial engineering department. This post will involve the management of one or more of the functions of direct labour control, the development of standards and estimates, scheduling, forecasting and methods improvement. A graduate mechanical engineer with five to ten years' manufacturing experience of some responsibility would be preferred, but persons with equivalent experience will be considered. This position will provide sufficient interest, authority, and salary to attract an exceptional man. File No. 5463-V.

LARGE TRANSPORTATION COMPANY in Montreal requires mechanical engineer to work on the staff of the electrical section of the mechanical department. The duties involve steam power plant layout, including piping, and other mechanical assignments. This is an opportunity for a recent graduate to obtain experience in this line of work. File No. 5464-V.

MECHANICAL ENGINEERS and engineering trainees required by engineering department in Toronto. Responsibilities will be design, load calculations, equipment selection, estimating and survey of air conditioning and refrigeration systems in the commercial and industrial fields. Positions offer employment with one of the world leaders in this field and will give excellent opportunity after training for advancement in application, construction or sales. File No. 5486-V.

A NORTHERN ONTARIO ASBESTOS producing mine has openings for the following personnel. Mechanical graduate engineer with several years experience some of which should preferably be in construction work. The work will be diversified with opportunity for advancement. Position open immediately. File No. 5491-V.

MECHANICAL ENGINEER, exceptional future for dependable man. General plant engineer for Toronto area. Some experience in manufacturing plants for medium heavy industry. Short training period in U.S.A. to learn product and methods to eventually work on lay-out of new plant and supervision of installation. File No. 5493-V.

MAINTENANCE SUPERINTENDENT for large mining operation in Ontario. A graduate mechanical engineer is preferred but applicants with some technical training and with good varied practical experience will be considered. A minimum of five years' experience preferably (but not necessarily) in the maintenance of equipment such as heavy diesel trucks, power shovels, jaw and cone crushers and screening equipment. Some machine shop experience is desirable. Age limit—50 years, good health essential. Company housing is not available but the company will assist the applicant in procuring suitable housing. Bilingual preferred, but not essential. File No. 5502-V.

RECENT GRADUATE IN MECHANICAL engineering with one or two years of experience preferably in the rubber industry. This is an excellent administrative opportunity for a young man to supervise product development programme in rubber, plastics and coated fabrics fields. This company has a comprehensive pension and welfare plan fully paid. Full details of experience and qualifications should be sent to the attention of File No. 5506-V.

THE RESEARCH DIVISION OF LARGE electrical organization in Ontario requires mechanical engineers experienced in the design and development of precise mechanisms, equipment mountings and enclosures as related to electronic computers and similar devices. Applicants should be capable of supervising a development group, and should be qualified engineers or holders of British Higher National Certificates. File No. 5509-V.

MECHANICAL ENGINEERS required by major consulting firm in Vancouver B.C., for design and layout of pulp and paper mills; conveyors and materials handling systems. Positions of supervisory nature available, to men with proper qualifications. Experience in pulp and paper mill construction or operation desirable, but not essential. Group benefits available. In reply please state experience, salary expected, availability. File No. 5511-V.

CONTRACTORS IN THE plumbing, heating, ventilating and air conditioning business located in Hamilton, Ontario, requires an ambitious young mechanical engineer who is keenly interested in the air conditioning field. We want a man who has had some experience in air conditioning and ventilating. His duties would be estimating and supervising the installation of the equipment and the sheet metal shop. Fle No. 5519-V.

MECHANICAL ENGINEER with 5 years or more experience in materials handling. Age 28-35, must be Canadian citizen and must be registered professional engineer in Canada or qualified. Position headquarters in Minneapolis, Minnesota, with heavy travel in Canada. Prefer man with materials handling or packaging experience in food industry but can consider others. Position offers good salary opportunity and permanence. Reply giving complete information, personal history, education and experience. File No. 5523-V.

GRADUATE MECHANICAL ENGINEER for plant engineering work in a large plastics and chemical plant. Up to 3 years experience in some or all of the following is required: estimating, piping layout and design, plant equipment layout, process and machine development, plant maintenance. This position offers experience in a wide variety of plant engineering problems, both mechanical, electrical and also in related economic studies. Replies should provide complete personal and professional details, when services would be available and salary expected. File No. 5527-V.

DESIGN ENGINEERS DRAFTSMEN ESTIMATORS

Applications invited by The Consolidated Mining and Smelting Company of Canada, Limited, at Trail, B.C., for experienced mechanical, structural and electrical designers, draftsmen and estimators for design and layout of equipment and buildings in our Metallurgical and Chemical and Fertilizers Plants. Application should be made in writing giving full particulars on education, experience, and stating approximate salary expected, to the Manager, Personnel Division, at the above address.

WE HAVE AN OPENING FOR A young graduate mechanical engineer in an engineering office. We are in the compressed gas industry CO^2, oxygen and acetylene. The man we want will be primarily interested in engineering problems rather than a mere administrative position involving an engineering background. He should be strong in theoretical thermodynamics and training, actual experience in instrumentation would be an advantage. The position is at our Montreal Head Office. The salary is open and of course we have pension life and health insurance benefits. File No. 5529-V.

MECHANICAL ENGINEER required by large manufacturer in Montreal for the planning department. Two or 3 years shop experience desirable preferably in production methods. Work will involve principally methods, investigations, materials handling problems, justification and selection of new equipment. File No. 5543-V.

SALES ENGINEERING opportunity for mechanical engineer or engineering physics graduate of 1954 or 1955 with manufacturer of heating, ventilating and air conditioning power plant and dust collecting equipment. We have a six months engineering graduate course in research design, application engineering and sales at our associate company in United States. Upon completion of your course you would return to our Canadian company for sales engineering work. Any inquiry for further information will be treated with greatest confidence. File No. 5546-V.

TOOLING ENGINEER—salary to $6,500, depending on qualifications. A graduate mechanical engineer with press tool and jig and fixture design and estimating experience in the Canadian light metals industry will be preferred. This is an opportunity for a fully qualified man to assume executive responsibilities. Employment in Oshawa. File No. 5551-V.

MECHANICAL DRAFTSMAN—for plant equipment modernization program. Salary to $90.00 per week. Plant engineering drafting, maintenance and equipment design experience preferred. Employment in Oshawa. File No. 5551-V.

MECHANICAL ENGINEER, experienced in plate fabrication work with some selling experience to help develop an industrial business. Location Province of Quebec. File No. 5554-V.

MISCELLANEOUS

THE QUEEN'S COMMISSION in the regular army opens a career of unusual importance, challenge and opportunities. It offers many rewards. The financial returns, the pension plan, the opportunities for advancement match, and in some way exceed those of any civilian profession or career. However, no one can measure the many intangible rewards of a leadership career in the service of Queen and Country. There are special opportunities and need for young graduate engineers in the Royal Canadian Engineers, The Royal Canadian Corps of Signals, The Royal Canadian Electrical and Mechanical Engineers. File No. 5276-V.

PROJECT AND CONSTRUCTION ENGINEER. Graduate in civil or mechanical engineering with furnace design experience in building structure, material handling equipment, structural and machine design. Supervisory ability in draughting. Experience in smelting operation or construction would be an asset. Fluent English is essential. File No. 5378-V.

INSTRUMENTATION ENGINEER to design measuring and control systems for chemical and metallurgical processes. Work includes preparation of flowsheets, wiring and piping diagrams, layout and detail drawings, detailed instrument specifications, cost estimates. Location Western Canada. Salary open. File No. 5391-V.

PHYSICAL METALLURGIST to undertake both fundamental and applied research on non-ferrous metals primarily lead and zinc and their alloys. Salary dependent upon qualifications and experience. Location Southern B.C. File No. 5391-V.

DESIGN ENGINEER, young graduate with several years production engineering experience and writing ability, for editorial work on new magazine. Good working conditions and remuneration in keeping with ability. With first letter give education and experience also starting salary requirements. File No. 5406-V.

YOUNG ENGINEER required for work in heating and ventilating company located in Ontario. Will be trained in the engineering, research and sales departments of the company with a view to eventual branch office work. File No. 5408-V.

YOUNG MINING OR CIVIL ENGINEER, preferably bilingual required by mining industrial plant near Montreal. Must be also good draughtsman and be responsible for plant equipment and plant expansion. Salary in accordance with experience. Write stating age, marital status, and experience. File No. 5419-V.

MECHANICAL OR CHEMICAL ENGINEER required by pulp and paper company located in P.Q. This engineer is required for our design engineering department and should have a minimum of 5 years experience with at least 2 years in pulp mill engineering. The salary is open for discussion. File No. 5421-V.

GRADUATE ENGINEERS for junior positions in the industrial engineering department of a large asbestos mine in the Eastern Townships. Applicants should be between 21 and 30 years of age, and have an engineering background. Experience in industrial engineering in heavy industry or large manufacturing enterprises preferable but not essential. Successful candidate will be given training in wage incentives and job methods. Excellent working conditions, extensive employee benefits. File No. 5427-V.

MECHANICAL OR STRUCTURAL ENGINEER, with steel fabrication experience required to take charge of detailing office, consisting of four draughtsmen and one estimator and to consult with architects and contractors to obtain suitable fabricating contracts. A thorough knowledge of welding, welding procedures and jig design required. This is an excellent opportunity in a well established Vancouver firm, employing approximately 50 men. Maximum salary and employment benefits to right man. Reply stating age, experience and salary required. File No. 5433-V.

AGRICULTURAL SALES ENGINEER required for metropolitan Montreal and Maritime provinces. Applicant should have university degree or equivalent in agriculture. Knowledge of French and chemistry desirable. Field of sales covers a line of agricultural chemicals to distributors in the Maritime Provinces supported by detailed sales and services work wtih dealers and growers; and sanitary and surfactant chemicals to industrial concerns in metropolitan Montreal. Applicant must be willing to headquarter in Montreal and be prepared to travel frequently into the Maritimes, taking up temporary residence there at a central location with his family during the active summer season. This latter provision subject to discussion. Apply by confidential letter giving details of education experience and general background to File No. 5438-V.

AGRICULTURAL AND/OR INDUSTRIAL chemical sales engineer required for Alberta and British Columbia territory. Applicant should have university degree or equivalent in agriculture or chemistry, have had three to five years sales experience in agricultural or industrial chemicals, possess strong administration interests and aptitudes and be willing to locate in Vancouver, B.C., area. File No. 5438-V.

UNIVERSITY TEACHER WANTED. The University of Saskatchewan wishes to receive applications from engineering graduates, Civil, Electrical, or Mechanical, under 35 years of age, to teach applied mechanics and allied subjects. Duties to commence January 1, 1956, the salary offered is $4.000.00 per year, and permanent appointment is a possibility. Apply to the Dean of Engineering, University of Saskatchewan, Saskatoon, Sask., giving age, qualifications, experience and references. File No. 5443-V.

THE GOVERNMENT OF British Columbia requires engineers and technicians for a multi-million dollar highway programme. Engineers: should have experience in highway location, design or construction. Professional registration desirable but not essential. Salaries range from $327.00-$464.00 per month depending on qualifications and experience. Benefits include compensation coverage, sick and vacation leave after one year; pension plan, statutory holidays. Opportunities for experience and advancement with a progressive programme in a fast growing province. File No. 5444-V.

RECENT UNIVERSITY GRADUATE required for inspection engineering miniature electronic components and assemblies. Location Montreal. Salary up to $4,620.00 depending on qualifications. Generous employee benefits. Good opportunity for advancement. File No. 5454-V.

REGISTERED PROFESSIONAL ENGINEER required for organizing and supervising inspection of materials, components and assemblies for weapons including auxiliary and ancillary equipment. Location Sorel, P.Q. Opportunity for continuing employment with advancement in due course. Salary commensurate with education and practical experience. File No. 5455-V.

LARGE CANADIAN ORGANIZATION handling quality precision instruments requires junior inspection engineer at Toronto. Only registered or graduate engineers with some experience in design production or inspection of instruments need apply. Starting salary up to $400.00 per month depending on experience. Opportunity for advancement. File No. 5456-V.

PROMINENT WEST COAST CONSULTING engineering firm requires graduate engineers with experience in the following categories: Mechanical, for design and lay-out of process plants, materials handling systems, process piping. Civil: structural design, field work, hydraulic systems. Electrical: industrial plant power systems. Please reply stating experience, salary expected and availability to File No. 5459-V.

EXCELLENT OPPORTUNITY FOR a recent Canadian university graduate 1952-1955, from either engineering physics or electrical engineering, for a sales position in the X-ray field. This position offers intensive training on X-ray equipment from six months to one year's duration and a sales engineer's position at the end of the training period. The possibility for advancement into a management position is excellent. This opportunity is located in Toronto. File No. 5460-V.

APPLICATIONS IN OWN handwriting will be received by the undersigned up to 4.00 p.m. January 31st, 1956, for the position of assistant engineer for the City of Brandon. Applicants must state age, marital status, qualifications and experience and state salary expected. File No. 5555-V.

APPLICATIONS ARE INVITED for the position of assistant professor of engineering at Mount Allison University. Particulars regarding the position may be obtained from the Dean of Science, Mount Allison University, Sackville, N.B. File No. 5568-V.

INDUSTRIAL ANALYSTS. Graduates in engineering or science wanted for large asbestos mine in Eastern Townships of Quebec. Applicants preferred who have training and/or interest in business administration or finance. Selected individuals would be trained to appraise and report upon the financial desirability of making capital and operating expenditures. Salary depends upon qualifications. Age 20-35 years preferred. Excellent living accommodations with good educational, social and recreational facilities available. Near large cities. Apply in writing, giving details of education, experience, marital status and salary desired. File No. 5462-V.

STIMULATING AND CHALLENGING positions with a future are opening up in our new and expanding research and development department in Montreal. At this time we have several responsible positions open (and others will be available during the coming months), for graduate engineers, chemists and physicists with experience in one or more of the following fields. Pressure sensitive adhesives; rubber and/or plastics; resins and coatings; textiles; cotton purification and processing, synthetic fibres, fine and specialty papers; paper containers; instrumentation. Modern well equipped lab. in our new research centre will provide excellent facilities and working conditions. Liberal benefits. Salaries commensurate with education and experience. Replies will be given all applications submitting a complete resume of personal data, educational background, work experience and recent photograph of themselves to File No. 5465-V.

APPLICATIONS ARE INVITED FROM ENGINEERS WITH MINING EXPERIENCE to act as technical representative in the sale of explosives to the mining and other industries. These positions will provide good opportunities for advancement in a new expanding organization. A knowledge of mining practices, particularly development and production, is necessary but previous sales experience is not essential. Applicants should be in their twenties or thirties. Please reply in writing giving details of education and experience to File No. 5468-V.

1954 OR 1955 ENGINEERING PHYSICS or electrical engineering graduate to work as an assistant to an advance development and/or product development engineer on colour television. To be located in Toronto. File No. 5473-V.

1953-4-5 ENGINEERING PHYSICS OR electrical engineering graduate to work as an assistant in radio advanced development, particularly on transistor circuitry. Location: Toronto. File No. 5473-V.

A RECENT ENGINEERING physics or electrical engineering graduate who has a good background in radio and television theory and practical work experience in laboratory, quality control, or similar work on radio and television to fill a position of release engineer on domestic radio and television receivers. Location: Toronto. File No. 5473-V.

A RECENT ENGINEERING PHYSICS or electrical engineering graduate with at least 4 years of laboratory experience as a product development engineer on domestic television receivers, to fill a position as a product development engineer on monochrome and colour television. To be located in Toronto. File No. 5473-V.

AN ENGINEERING PHYSICS OR electrical engineering graduate, who has had experience on layout, design and construction of microwave systems to fill a position as senior communications system engineer. Location: Toronto. File No. 5473-V.

MONTREAL CHEMICAL FIRM requires 2 chemical engineers with at least three years' experience in the selection of chemical plant equipment and piping layouts. Two recent graduates with some experience in chemical manufacturing design or operation. Two mechanical engineers with at least three years' experience in the selection of equipment and the layout of manufacturing plants. Two recent graduates with some experience in process equipment design or operations. Applicants should be between the ages of 23 and 35, and application may be made in writing, giving a brief summary of training and experience to File No. 5475-V.

SALES AND SERVICE ENGINEER for Eastern Canada to take over Montreal office of established firm specializing in the distribution and servicing of equipment for the pulp and paper industry. Liberal commission, $3,600.00 annually guaranteed. Bilingual preferred with a minimum of four years experience in a pulp and paper mill. File No. 5476-V.

ENGINEER-CHEMICAL OR CIVIL preferred, to take charge of construction department for old established manufacturer. Guaranteed salary plus profit sharing plan—usual benefits available—an excellent opportunity for the right man. Some construction or maintenance experience essential. File No. 5478-V.

RECENT ENGINEERING graduate either electrical or mechanical with some electrical experience for a permanent position as plant engineer. We are manufacturers of aluminum extrusions and are at present engaged in an expansion program of plant and equipment. Applicant need not have experience but preferably good electrical background. Training period provided. Location: Province of Quebec. File No. 5485-V.

UNIVERSITY TEACHERS WANTED. Chemical Engineering, Civil Engineering, Electrical Engineering, Mechanical Engineering, Metallurgical Engineering. Salary ranges: lecturer, $3,720.00 to $4,200.00. Assistant professor $4,380.00 to $5,100.00 with superannuation and hospital insurance. First appointment will depend upon qualifications and experience. Opportunities for advancement to higher ranks in an expanding institution. Some positions available January 1st, 1956. All must be filled by September 1st, 1956. Research and professional employment encouraged. Apply to The President, Nova Scotia Technical College, P.O. Box 1000, Halifax, Nova Scotia. File No. 5487-V.

BILINGUAL SALES ENGINEER required preferably mechanical electrical, by long established company, leader in its industry. Location: Montreal. Age approximately 30 years. Sales organization with small staff offering excellent prospect for advancement. Applicants must be able to deal with owners and top executives. Remuneration commensurate with ability and experience. In reply give all details of age, marital status, education, experience. File No. 5488-V.

PHYSICIST OR METALLURGIST, recent graduate, interested in solid state physics required for work on fatigue. Work involves non-destructive testing methods. Previous experience advantageous but not essential. Excellent working conditions. Please reply to File No. 5490-V.

MINING ENGINEER, recent graduate, the work will be both in open pit and underground and will include underground caving operations. Position open January 1st, 1956. All benefits including pension plan, salary commensurate with ability. Apply stating age, salary required, education and experience to File No. 5491-V.

EQUIPMENT MANAGER required by transportation company headquarters in Whitehorse, Yukon Territory. Applicants must be graduate engineers, mechanical, mining, metallurgical or civil between the ages of 40-45 years with at least ten years experience in the selection, operation, and repair of automotive, crawler and contractor's work equipment or mechanical equipment used in open pit mining operations and motor truck transport. Business administration experience desirable but not essential. Married man preferred housing available. State salary required and forward references and application along with recent photo and record of salary progression to date. Interviews will be arranged at suitable point if applicants justify. File No. 5492-V.

EXCELLENT OPPORTUNITY to become established in fast growing fluid power field. Sales engineers required by large manufacturer of air and hydraulic cylinders to be located in Ontario and Quebec. Applicants should have some engineering training or background and knowledge of machine tool application. Salary, travelling expenses, plus commission. File No. 5497-V.

CHIEF OF RELAYING STUDIES. Graduate professional engineer to prepare design and specifications of relay protection for power systems with 2 million horse power generating capacity, to carry out analysis of relay operation and to supervise training of relay personnel. Should have at least 5 years' experience in this class of work and be under 40 years of age. Location: Brazil. File No. 5500-V.

GRADUATE ENGINEER required by major oil company for sales engineering positions in Montreal and surrounding territory. Involves broad training in all petroleum products and their application in industry. Experienced and bilingual engineer preferred between 25-30 years of age. File No. 5504-V.

CIVIL OR MECHANICAL ENGINEER with design and field experience in industrial building construction, with knowledge of machine foundations, building alterations, etc. This person should have 5-10 years experience and be 32-40 years of age. This is a permanent position with a large nationally known company with head office in Montreal. When replying, please give a short summary of qualifications, experience and approximate salary desired. File No. 5505-V.

ENGINEERS REQUIRED BY NATIONAL Research Council, Ottawa. Honour graduates and post graduates in aeronautical engineering, chemical engineering, civil engineering, electrical engineering, electronics, engineering physics, mechanical engineering for research and development work at Ottawa. Applications or enquiries are invited from recent high ranking university graduates, particularly honour graduates from Canadian universities. File No. 5514-V.

GRADUATE ENGINEER for general engineering work on special equipment in Canadian industry. Duties may cover construction, testing and servicing of equipment. Must be free to travel. Salary open. File No. 5507-V.

SENIOR ENGINEERING POSTS with B.C. power commission. Opportunities are open for the following positions of supervisory level, each requiring 8 to 12 years appropriate experience in hydro utility work. Civil design engineer experienced on structural design of dams, penstocks hydro plants, capable of preliminary studies, investigations and reports on hydro developments and with a wide knowledge of soil problems. Station electrical design engineer experienced in electrical design of generating and switching stations, including relay and carrier applications. Construction engineer, qualified in civil engineering to assist in administration organization and overall supervision of plant and line construction, with construction experience and knowledge of design problems. Applicants should be registered professional engineers in B.C. or clearly capable of immediate registration. All positions are in Victoria, B.C., and of a permanent nature. Salaries are commensurate with capabilities and experience. Pension and other benefits available. Further information on request, or application giving age, education and chronological experience may be made directly to File No. 5515-V.

THE GENERAL ATOMICS DIVISION of Canadair Limited, Montreal invites application from engineers. This newly organized nuclear division has openings for engineering designers with layout, design and development experience in the following categories. Mechanical equipment, hydraulic systems, including: pumps, tanks, valves, pipes and heat exchangers; plant layout process instrumentation systems, electrical or electronics circuitry; nuclear reactors. Here is a splendid opportunity to get in on the ground floor of a new and expanding field with a well established company. Please send details of education and experience to File No. 5516-V.

RAPIDLY EXPANDING CHEMICAL organization with headquarters in Toronto requires graduate chemical and mechanical engineers with over 3 years chemical plant design experience to work in Toronto office. Also required two chemical engineers for chemical sales with 2 to 8 years sales experience. File No. 5517-V.

OIL AND GAS PROCESS engineer required by Western Canada contractor engineering firm. Must have experience in plant design and flow studies and be capable of supervising entire project from contact to completion with full responsibility. Permanent position with growing concern. An excellent opportunity for right man, immediately. Write giving complete resume of age, education, experience and references. State salary required. File No. 5518-V.

YOUNG ENGINEER required by consulting engineers, for design of hydro-electric structures, and thereafter for work as assistant resident engineer in the field. File No. 5520-V.

FOUR QUALIFIED ENGINEERS preferably graduates in mechanical or civil engineering from Canadian universities are required for a large newsprint and pulp mill in the province of Newfoundland. Experience in the pulp and paper industry is preferred but not essential. Two of the positions will require engineers with 5 to 10 years experience. While the other 2 positions could be filled by recent graduates. Preference will be given to those applicants who apart from engineering training, have some administrative experience. A broad outline of the work covered is briefly: design, layout, process development and maintenance control, depending upon applicants experience and interest. Applications should be made in writing to File No. 5521-V.

TECHNICAL REPRESENTATIVE IS required by a national industrial association in the field of pressure preservative treatment of timber throughout Canada. We visualize a man at least 30 years of age, a graduate engineer or equivalent, with experience in some part of the construction industry and interest in trade promotion. He should be able to write for the technical and non-technical press and be able to address groups of people of professional and lay backgrounds. A knowledge of the timber industry and particularly of pressure treating is desirable but not essential. Bilingual ability would be an asset and our representative must be willing to travel across Canada. Equivalent experience or special abilities will be carefully considered in analysing application. Headquarters will be Ottawa. Salary open. All replies strictly confidential. Apply in writing with resume and photograph to File No. 5525-V.

A CANADIAN COMPANY offers a once-in-a-lifetime opportunity to an engineer with a talent for selling as district manager, with headquarters in Toronto, representing a long established and leading manufacturer of equipment for power plants, paper mills and chemical process industries. High salary, liberal bonus. File No. 5532-V.

OPPORTUNITY CREATIVE DESIGN engineer. Excellent opportunity to gain senior position with small growing company, expanding primarily in the aircraft accessory field. Applicant must have drive, initiative and ability to assume responsibility, coupled with a flair for creative designing. Sound basic engineering knowledge is essential, experience in designing aircraft, electrical and mechanical accessories is desirable, but providing applicant has sound basic engineering knowledge, he could soon qualify for our type of work. In this position an engineering team would be developed under his supervision and he would be given considerable freedom in his work. Applicants should write fully giving previous experience and salary required. File No. 5533-V.

SALES ENGINEER required by well established and highly respected company in the field of scientific illumination. Duties after a specific training program will involve the sale of prismatic lighting units and the discussion of lighting applications with architects, consulting engineers and electrical contractors, officials of industrial and commercial firms, municipal and hydro officers. Qualities of personality, diligence and dependability along with a sincere desire for a permonent career in the lighting industry are of prime importance. File No. 5536-V.

ENGINEERS REQUIRED BY Toronto manufacturer of fuel control systems for aircraft gas turbine engines has openings in the following fields: Electronics engineer, graduate electronic engineer experienced in design and construction of experimental equipment. Knowledge of magnetic amplifiers essential. Capable of independent work on servo-mechanisms for aircraft application. Performance engineer with a degree in engineering or science and a strong mathematical background. A knowledge of hydraulics and aerodynamics essential. Experience in servo-mechanism controls most desirable. Development engineers graduate mechanical engineers preferably with a background of experience in aircraft hydraulics. Experience in servo-mechanism controls an asset. Apply with full particulars indicating salary requirements to employment officer. File No. 5537-V.

MECHANICAL OR CIVIL ENGINEER required to act as field engineer on construction projects. 8 to 10 years engineering experience desirable plus ability and initiative. Comprehensive medical plan and pension plan in operation. In reply give age, experience, marital status and salary expected. File No. 5540-V.

EXPANDING DEVELOPMENT on the most advanced specialty steel mill equipment requires engineers who have had experience in the designing of heavy machinery and steel mill equipment. Also the services of an industrial engineer qualified to assume supervisory responsibilities, and perform project work and in the combustion engineering section we would be willing to train a young engineer whom we feel could assume supervisory responsibility. Contributing to your security are extra benefits such as a generous plan, hospitalization and group life insurance schemes. File No. 5544-V.

AN ESTABLISHED CANADIAN COMPANY requires a graduate engineer experienced in plant layout and production methods to assist in getting into production, a new plant in the Toronto-Hamilton area. Knowledge of sheet metal fabrication an asset. Age range 30-40. File No. 5545-V.

TIME STUDY MAN—salary to $5,000 per year. This position requires a trained, experienced man capable of supervising methods and time studies for standard hour incentive plan in an Oshawa light metals industry. Experience with continuous stop watch time studies and predetermined time standards will be preferred. File No. 5551-V.

INDUSTRIAL SALES REPRESENTATIVE—employment in Montreal and province of Quebec. Salary up to $5,000 plus expenses. Sales engineer type with successful experience in the sale of partly manufactured light metal products to Canadian industrial accounts preferred. Bilingualism advantageous. File No. 5551-V.

FOUR QUALIFIED ENGINEERS

preferably graduates in mechanical or civil engineering from Canadian Universities, are required for a large Newsprint and Pulp mill in the Province of Newfoundland.

Experience in the pulp and paper industry is preferred but not essential. Two of the positions will require engineers with five to ten years experience while the other two positions could be filled by recent graduates. Preference will be given to those applicants who, apart from engineering training, have had some administrative experience.

A broad outline of the work covered is briefly: design, layout, process development and maintenance control, depending upon applicant's experience and interest. Applications should be made in writing to File No. 5521-V.

ATTENTION EMPLOYERS

30 Engineers Available May 1956 for Permanent and Summer Employment

These Canadian Engineers are proceeding to their Masters Degree in Business Administration at the School of Business Administration, University of Western Ontario.

Degrees Held:	Civil Engineering,	Engineering and Business,
	Chemical Engineering,	Mechanical Engineering,
	Electrical Engineering,	Petroleum Engineering.

Approximately half of the group will be interested in summer employment only.

A descriptive booklet with pictures and resumes of all graduate students is available on request.

Write to:

N. M. Armstrong, Placement Director,
School of Business Administration,
University of Western Ontario, London, Canada.

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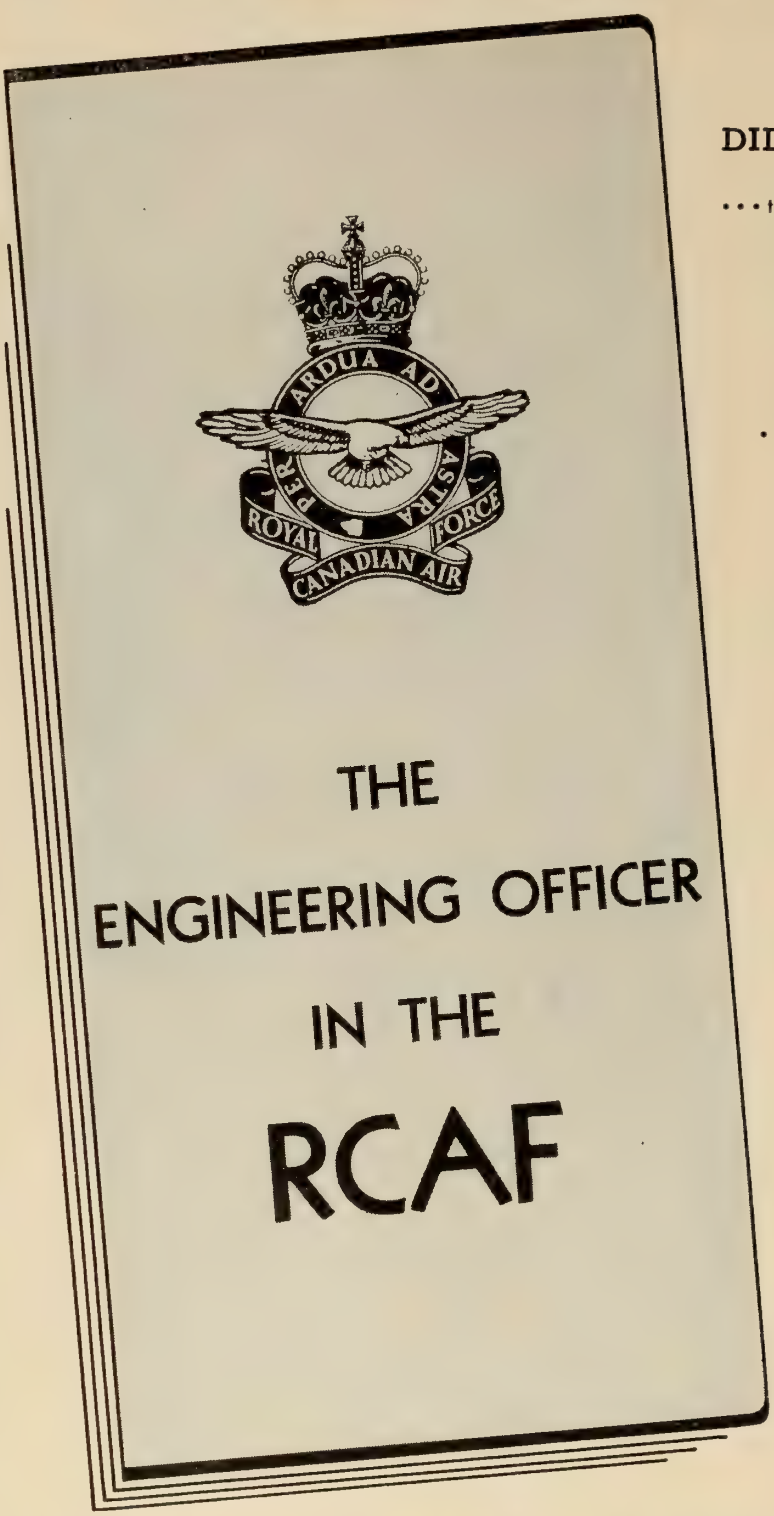
A CAREER IN ENGINEERING

Here's A Brochure You Should Read!



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• • • for certain advanced engineering projects, he may be selected for post-graduate studies at a university in Canada, the United States or the United Kingdom.

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ROYAL CANADIAN AIR FORCE

BUSINESS & INDUSTRIAL BRIEFS

A Digest of Information

received by

The Editor

Appointments and Transfers

Monsanto Promotion.—The promotion of Aubrey K. Briggs to the position of supervisor of sales service, resins and adhesives, is announced by Dr. A. F. McKay, director of research and development for Monsanto Canada Limited.

●

C.G.E. Appointments.—The appointment of Kenneth L. Broe as manager, Alberta, in charge of Calgary, Edmonton, and Trail Branches of the Pacific District of Canadian General Electric Company's apparatus department has been announced by A. M. Thompson, district manager.

The appointment of John Dalton as sales manager, apparatus and supplies, for the Western Ontario District of Canadian General Electric Company's wholesale department has been announced by W. J. Packham, district manager.

●

Dominion Bridge Appointment.—R. C. Pearse, vice-president and manager, Ontario Division, Dominion Bridge Company Ltd., announced recently that George Evans, assistant contract engineer, has been appointed assistant sales manager.

George Evans

Enfield Cables Ltd.—Enfield Cables Ltd., announce the appointment of J. Morgan Blades as their resident engineer in Canada. Mr. Blades, who took up his appointment in December, 1955, is located in Montreal. For the last six years Mr. Blades has been with the Hydro-Electric Power Commission of Ontario. It is also announced that W. E. Gardner has been appointed managing director of Enfield Cables (Australia) Pty. Ltd.

●

Canadian Western Pipe Mills.—Announcement is made by Canadian Western Pipe Mills Limited, Port Moody, B.C., of the appointment as president and director of Brig. William Murphy, C.B.E., D.S.O., Q.C., LL.D. Simultaneous announcement is made of the appointment as executive vice-president of Ralph Wiesinger. Other members of the board of directors are Col. The Hon. Clarence Wallace, C.B.E., Dr. Heinrich Hofmeier, R. M. Reiner and Dr. Karl Bender.

Completion of the inaugural organizational phase of the Canadian Western Pipe Mills under the direction of Richard M. Reiner has taken place, and the company is now embarking on the production phase of its operation—procurement of materials, fabrication, transportation and sales.

●

Canadian Resins and Chemicals.—The appointment of John R. Charlton to the newly-created position of manager, new product development, Canadian Resins and Chemicals Limited, is announced by R. J. Southwell, executive vice-president. Mr. Charlton is located at the Company's head office in Montreal.

●

Minnesota Mining & Manufacturing.—The appointment of M. J. Martin to the position of sales manager, administration, of Minnesota Mining & Manufacturing of Canada Limited, London, Ontario, has been announced by Roy W. Keeley, director of sales. Mr. Martin will act as liaison between various product managers and supervisors assisting them, through the director of sales, in formulating merchandising and sales plans. In addition, he will continue as administrator of the advertising and sales promotion departments.

M. J. Martin

●

Canadian Construction Association.—The appointment of Geoffrey Mellor to the headquarters staff of the Canadian Construction Association is announced by C.C.A. President W. G. Malcom, of Winnipeg, Manitoba. At Construction House Mr. Mellor is acting as a general assistant. He is the C.C.A.'s official representative at the opening of tenders for construction projects called by the various Federal departments and is in charge of sending out tender reports to interested members. He also will be taking over C.C.A. office activities in the field of apprenticeship training.

●

Resident Geologist for Montreal.—Dr. J.-E. Gilbert formerly resident geologist for the Rouyn-Noranda district of Northwestern Quebec has been appointed to the same post for the region of Montreal, it was recently announced by Hon. W. M. Cottingham, Quebec Mines Minister. His principal duty will be to carry on the gathering, co-ordination and compilation of all geological information in the district in view of assisting in the development of its mineral resources.

●

Bus. and Ind. Briefs

T. Veliotis

R. Black, general manager, Davie Shipbuilding Limited, Lauzon, Que., announces the appointment of T. Veliotis, B.Sc. (Eng.), as manager of the general engineering division of the company. Mr. Veliotis was formerly shop superintendent of this division.

New Equipment and Developments

Change of Address.—Canadian Bechtel Limited moved to new offices at 25 King Street West, Suite 1030, Toronto, Ont. (tel. EM. 3-5737), in December.

●

New Branch Office.—Proctor, Redfern and Laughlin, consulting engineers, announce the opening of a new branch office (replacing 1660 Kingston Road) at 2625 Eglinton Ave. East, Scarborough, Ont. (tel. AM. 7-4641).

●

Move After 50 Years.—E. G. M. Cape and Company, Montreal, marked 50 years in the engineering and construction field at the close of 1955 by moving into a new office building in Montreal, at 4898 Western Avenue. J. B. Stirling, M.E.I.C., president of the company, and a past-president of the Canadian Construction Association, of the Engineering Institute of Canada, and of the Montreal Board of Trade, said completion of the new building marked the Company's 50th year of operation. It is the oldest construction firm in the Province of Quebec to operate continuously under one name, and is one of the oldest in Canada.

●

New C.G.E. Building.—The new office and warehouse building of Canadian General Electric Company in Hamilton, at 505 Woodward Avenue, ready in December, will be occupied by the head office staff of the Western Ontario district of the wholesale department; the field service engineer, electronic equipment and tube department; and the Hamilton sales office of the apparatus department. The new building contains 65,000 square feet of floor space. Facilities include a service shop, a combination auditorium and display room and a completely equipped employee cafeteria. Customer conveniences include counter service and a full stock of renewal parts.

●

Canadian Aviation Electronics.—CAE's Quebec Branch will operate from a newly constructed 19,000 sq. ft. building in Ville St. Laurent, Que., early in 1956. The modern office, service and warehousing facilities are located at 312, Montee de la Cote de Liesse, not far from CAE's $3,000,000 head office and main plant. In making the announcement, Mr. K. R. Patrick, O.B.E., president and managing director, stressed the fact that this will be the second new building to be occupied by a CAE branch in the New Year. A 16,000 sq. ft. building is at present being completed on Fraser Street, in Vancouver to house CAE's West Coast branch offices and factory.

It is also announced that Canadian Aviation Electronics Limited recently concluded an agreement with the Allen B. Du Mont Laboratories in the United States according to which, CAE has acquired the control of all Du Mont Canadian patents, covering the manufacture and sale in Canada of cathode ray tubes, television sets, transmitters and other electronic instruments.

●

Construction Equipment Companies Join.—Watson Jack & Company Limited, and F. H. Hopkins & Company Limited, which have been in the business since 1898 and 1904 respectively, have now combined and, from 1st January, 1956, will operate under the name of Watson Jack-Hopkins Limited. Both companies have been wholly-owned by the B. J. Coghlin Co. Limited, which will continue to be the parent company. The officers of the new company are: president, F. O. Peterson; executive vice-president, S. H. Dobell; vice-president, S. A. Stephens, Jr.; vice-president and Ontario divisional manager, M. F. Macdonald; secretary, G. I. Shaw; treasurer, K. Patchett; A. Moncel is sales manager for the Province of Quebec; R. W. Chorlton is manager of Ottawa region, and Ian Houston, manager of North Bay region.

●

New Company Formed.—F. M. S. Best, managing director of Rootes Motors (Canada) Ltd., A. G. S. Griffin, managing director of Triarch Corp. Ltd., D. C. Russell, treasurer and director of Rootes Motors (Canada) Ltd., and H. B. Edwards, sales manager of Canadian Lister-Blackstone Ltd., have been appointed directors of Canadian Lister-Blackstone Ltd., it has been announced jointly by Sir Percy Lister and Sir William Rootes, both of whom will also serve on the board. The new company, with head offices in Toronto and plants in Vancouver and Montreal, is sole concessionnaire in Canada for the line of British-made Lister and Blackstone diesel engines, for marine, stationary and industrial use, covering a range from three to 600 h.p. Lister engines were first marketed in Canada in the late 1800's.

●

Company Consolidation.—C. R. Long, president of E. Long Limited, Orillia, has announced plans for the consolidation of the Canadian operations of E. Long Limited with those of Dorr-Oliver Inc., Stamford, Conn. The proposed new organization will be known as Dorr-Oliver-Long Limited, effective January 1, 1956. The headquarters of the consolidated company will be in Orillia, with the present Toronto office of Dorr-Oliver Inc. and the Vancouver office of E. Long Limited operating as divisional sales offices. Mr. Long, at present a director of Dorr-Oliver Inc., will be the president of the enlarged organization. The manufacturing facilities in Orillia consist of machine shops, structural steel shops and a Meehanite foundry with extensive pattern storage capacity. All buildings for manufacture are equipped with cranes and machine tools for the production of heavy engineering machinery.

●

Bristol Aeroplane Reorganizes.—Because of the continuing expansion of activities in Canada, a re-organization of the Bristol group of companies has been carried out which will have the effect of consolidating the group under a single Canadian parent company. This will be known as The Bristol Aeroplane Company of Canada (1956) Limited, situated at 223 International Aviation Building, Montreal, and will control three operating subsidiaries in Montreal, Vancouver and Winnipeg—Bristol Aero Engines Limited, Bristol Aero Engines (Western) Limited, and Bristol Aircraft (Western) Limited, the last named being the business formerly operated by MacDonald Bros. Aircraft Limited.

●

Electronic Expansion.—Acquisition of new premises with over 3,000 square feet of fully-modern self-contained plant and office space has been announced by Stanley E. A. Pinnell, president of Pylon Electronic Development Company, Ltd., of Montreal. At the same time, the appointment of Al Patterson, P.Eng., was announced as manager of the company's newly formed Toronto sales office.

●

Carbon and Graphite Electrodes.—Expansion of carbon and graphite electrode production facilities at Welland, Ontario, is announced by National Carbon Company, Division of Union Carbide Canada Limited. According to J. S. Dewar, president, this expansion is in keeping with long-established policy of gearing manufacturing capacity to anticipated future requirements. Completion of current plans early next year, will result in increasing baking and graphitizing facilities by approximately 20 per cent.

Carbon and graphite electrodes are used in a wide variety of electrothermic operations such as melting and refining of steels, melting of non-ferrous metals, electric smelting processes, production of fused alumina abrasives, titanium dioxide slag and ferro-alloys. New and more highly purified grades of graphite have been specially developed for use as moderators, reflectors and thermal columns in experimental and commercial nuclear reactors.

Bus. and Ind. Briefs

New Epoxy Manufacturing Company.—The Bate Chemical Corporation, Ltd., Toronto, Ont., and Houghton Laboratories, Inc., Olean, N.Y., have formed a joint company in Canada to manufacture and market Hysol products, which consist of epoxy electrical insulating materials, adhesives and tooling compounds. G. H. Clifford Smith of Bate Chemical Corp., Ltd., is president of the new Canadian company to be known as Hysol (Canada) Ltd., and Russell H. W. Smith, an electrical engineer of Toronto, is sales manager. Offices of Hysol (Canada) Ltd., are at 184 Laird Drive, Leaside, Toronto 17, Ont.

●

German Industries Fair.—The 1956 German Industries Fair covering industrial and consumer goods is to be held at Hanover from April 29 to May 8. Mechanical and electrical engineering industries are prominent among the exhibitors, according to a comprehensive brochure which is available, together with all other information on the Fair, from the Canadian representative, The Trimont Corporation Ltd., 1170 Drummond St., P.O. Box 25, Montreal, Que.

●

Avro Anniversary.—A. V. Roe Canada Limited recently celebrated their 10th Anniversary. The winter, 1955, issue of *Jet Age* attractively presents the story, written by Scott Young, of the achievements of the company during these ten years.

●

Refrigeration Show.—The 2nd Canadian Refrigeration and Air-Conditioning Show will be held in the Coliseum in Toronto, on February 1, 2 and 3. Sponsored by the Canadian Refrigeration Manufacturers Association, this all-industry show contains over half a mile of exhibits displaying the latest developments in the fields of refrigeration and air-conditioning, plus the finest equipment for commercial, industrial and domestic application. During the first two days (Feb. 1 and 2) admission is by ticket only. The show will be open to the public on the final day. Businessmen desiring to attend the show are asked to write for free tickets to: Sec'y-Manager, 2nd Canadian Refrigeration and Air Conditioning Show, Room 1209, 137 Wellington St., West, Toronto, Ontario.

●

Canadian Contributions to Geophysics.—Roy L. Adams is to supervise production engineering on the type T609 auroral recorder, one of Canada's contributions to the International Geophysical Year which starts in 1957. This was made known by J. M. Bridgman, managing director of PSC Applied Research Limited in announcing Mr. Adams' appointment as production coordinator of the Toronto company. The auroral recorder, which measures the light intensity of the Aurora Borealis was developed by a group under Dr. Donald Hunten at the University of Saskatchewan with the aid of the National Research Council and the Defence Research Board. PSC Applied Research Limited has been given a contract by the Canadian Government to build the first unit.

The company also announce that their Canadian-developed and produced magnetometer has been used to discover more than one hundred million tons of good quality ilmenite in South West Norway. This valuable ore is used in the making of jet engines, paints and other products. The find has been christened the Tellnes deposit.

Publications

Industrial or trade publications received recently cover many fields of interest to engineers. For copies of those mentioned below, please apply to the issuing company (mentioning *The Engineering Journal*).

Bathurst Packaging Handbook.—A comprehensive, illustrated loose-leaf book covering many aspects of packaging, such as design, construction, testing, freight regulations. Bathurst Power & Paper Co. Ltd., Container Division, Sun Life Building, Montreal 2, Que.

●

Barometric Condensers.—A bulletin, Form 9012-A, describing barometric condensers of the disc-flow and ejector-jet types. Canadian Ingersoll-Rand Co. Ltd., 620 Cathcart St., Montreal, Que.

●

Rock Bolts.—Brochure describing types and applications of rock bolts. The Steel Company of Canada Ltd., Hamilton, Ont.

●

Liquid Level Transmitter.—Bulletin 13-22, describing closed tank liquid level measurement and control with Type 13 LA d/p cell liquid level transmitter. (The Foxboro Company.) Peacock Brothers, P.O. Box 1040, Montreal, Que.

Safeguarding Construction.—Well illustrated booklet describing the inspection of construction from site to finished project as part of the services offered by the company. (Publication No. 102.) The Warnock Hersey Co. Ltd., 128 Elmslie St., Montreal 32, Que.

●

Diamond Anniversary. — Illustrated booklet marking 75th anniversary and describing services of J. T. Donald & Co. Ltd., 1181 Guy St., Montreal, Que.

●

Bishop Signs.—Catalogue No. 60, summarizing metal letter and allied product data. H. B. Tompkins & Son, 733 Versailles St., Montreal, Que.

●

Carboloy Blanks and Tools.—Catalogue SBT-17 covers grades, styles, and specifications of "throw-away" insert blanks; new pricing information on Carboloy standard tools and blanks is given in bulletins 54CT and SBT-7B. Carboloy Section, Canadian General Electric Co. Ltd., 1025 Lansdowne Ave., Toronto, Ont.

●

Power Generation Equipment.—Publication No. 2404 deals with large steam turbines; No. P-2560 deals with large generators used with the turbines, also details of other equipment. (The General Electric Company Ltd., of England.) Fraser & Chalmers of Canada Ltd., 1411 Crescent Street, Montreal 25, Que.

●

Shellcast Brochure.—Esco Shellcast Brochure No. 205 covers the shell-moulding process, showing some of its applications and advantages. Esco Limited, 146 East 1st Ave., Vancouver 10, B.C., or 2480 Dufferin St., Toronto, Ont.

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News of the Associations and Corporation

(*Continued from page 52*)

on Friday night, and the convention culminated with the annual dinner dance which overflowed the Empress ballroom on Saturday.

Engineers in the News

Charles Bentall, chairman of the board of directors of the Dominion Construction Co. Ltd., recently announced the appointment of **H. C. Bentall** as president and **R. G. Bentall** as vice-president of the Dominion Construction Co. Ltd., Bentall Construction Co. Ltd., and their associated companies.

D. D. Morris has been appointed to the newly-created position of assistant to the general manager of the Consolidated Mining and Smelting Company. He had served as administrative assistant since January, 1954, and had previously been manager of the research and development division.

J. M. Bezer has opened new Calgary offices for Eric Ackland and Associates Ltd., from which he will handle mechanical and electrical lines throughout southern Alberta. Mr. Bezer is a 1950 mechanical graduate of the University of British Columbia.

M. J. Shelley, a University of British Columbia civil graduate of 1955 has won the first Engineering News Record Fellowship for graduate study in the field of public works engineering and administration. The award was based partly on a paper on the design and operation characteristics of the City of Vernon's sewage treatment plant.

Mr. Shelley worked this summer under **F. G. deWolf,** city engineer of Vernon, and has now returned to the University of British Columbia to take his master's degree.

R. N. Gordon, division engineer with the Department of Fisheries in Ottawa, has been transferred to Vancouver where he will continue his work with the Department. Mr. Gordon is a graduate of the University of British Columbia and had previously been with the Department of Fisheries in Vancouver from 1949 to 1954.

D. A. Pirttinen has resigned from the process department of Foundation of Canada Engineering Corp. Ltd., Toronto, and is now associated as project engineer with Catalytic of Canada Construction Co. Ltd., of Sarnia.

J. M. Fitzsimmons has accepted a position with H. A. Simons Ltd. He was previously employed by Canadian Forest Products at Port Mellon.

A. R. M. Stewart has accepted a position with Sandwell and Co. Ltd. in Vancouver. He was previously plant engineer at Powell River and was with the Powell River Company for the past 15 years.

R. G. Foxall has joined Northern Construction and J. W. Stewart Ltd. and will be engaged on work in connection with the expansion program of the Powell River Company. He was with Canadian Forest Products at Port Mellon.

J. H. Eastman has been transferred from Canadian Exploration Ltd., Salmo, B.C., to Pato Consolidated Gold Dredging Ltd., Barranquilla, Colombia, S. America, where he expects to stay for at least two years.

G. H. MacKay, formerly with the Department of Public Works of Canada in New Westminster is now in Winnipeg working for the P.F.R.A.

J. R. Wallis, who recently obtained his master's degree in forest engineering from Oregon State College, has accepted a position teaching at the Montana State University School of Forestry.

J. Moroney is now with Dawson, Wade and Macco engaged in hydro work in the Upper Campbell Lake district. Mr. Moroney was previously assistant to the municipal engineer of Esquimalt.

L. Dotto has accepted a position with the Canadian Western Lumber Co. at New Westminster. He had previously been with H. A. Simons Ltd.

D. J. Turland, of the apparatus division of Canadian General Electric Co. Ltd., has been transferred from Vancouver to Trail where he will be apparatus sales engineer for that district.

R. H. Ferguson has accepted a position with H. A. Simons Ltd. He was previously with Vancouver Iron Works Ltd.

W. T. Harrower, of Dominion Bridge Co. Ltd., was recently elected chairman of the Vancouver chapter of the Canadian Welding Society.

D. I. Cameron is now with the B.C. Electric Co. Ltd. as a protection test engineer. He had been employed by Barvic Engineering Ltd.

R. H. Elfstrom was recently re-elected president of the Greater Vancouver Health League. Mr. Elfstrom is supervisor of industrial safety for B.C. Electric Co. Ltd.

H. Matthews was recently appointed chief engineer of the Victoria Machinery Depot Co. Mr. Matthews had been chief engineer and plant manager of Vancouver Iron Works Ltd. and Vancouver Engineering Works Ltd. and had been employed by that firm since 1928.

H. T. Ramsden has been appointed to the position of district engineer, Water Resources Division, Department of Northern Affairs and National Resources. He is a native of British Columbia and a graduate of the University of British Columbia.

Mr. Ramsden served with the R.C.E. Corps during the late war, and returned to service with the Water Resources Division, where he has held the post of assistant district engineer for six years. He succeeds **W. C. Warren,** the retiring district engineer.

D. C. Gough has accepted a position with Swan, Wooster and Partners, as resident engineer on the Kelowna bridge. He will leave his former position of construction engineer with the Pacific Great Eastern Railway at the beginning of the year.

D. C. Codville, who has been with Giant Yellowknife, recently accepted a position with Northern Construction Co. and J. W. Stewart Ltd., and will be engaged in work on the removal of Ripple Rock.

J. A. Wallace, formerly with Mobil Oil of Canada Ltd. in Canada and more recently district geologist for that company in Edmonton, has been transferred to the head office of the parent company, Socony Mobil Oil Company, Inc., at 26 Broadway, New York 4. In his new assignment, Mr. Wallace will be concerned with the company's Canadian operations.

D. A. Duguid has accepted a position with Bumstead-Woolford Ltd. of Vancouver and Seattle and will take over his new duties in Vancouver at the first of the New Year. Mr. Duguid was previously in the marketing division of the Imperial Oil Company.

Cyril Jones will officially retire from his position as city engineer at Victoria at the end of December.

A. R. Luck has left his position with the electric department of the Vancouver City Hall to join the staff of Canadian Westinghouse Co. Ltd. in Vancouver.

E. A. Bianco, a '52 civil graduate of the University of British Columbia, is now attending Stanford University at Stanford, California. He is working towards his master's degree in engineering administration.

T. L. Horsley has accepted a position with Granby Mining, Smelting and Power Company at Copper Mountain, B.C. He was previously with Taiga Mines.

J. W. Lee has been promoted to the position of senior geologist with Kaiser Aluminum and Chemical Corp. He has been in Jamaica with the Kaiser Bauxite Company.

D. H. Rutherford of Stone and Webster Engineering Corp. has been transferred from Concrete, Washington, to Seattle.

C. H. Morrison, a '55 mechanical graduate of the University of British Columbia, has taken a position with A. L. Swanson and Co. in Vancouver. He was previously with the B.C. Power Commission in Victoria.

W. C. Sellens has left the traffic engineering department of the B.C. Telephone Company to take a position with the engineering branch of the marketing department of the Imperial Oil Company in Vancouver.

G. R. Hilchey has accepted the position of mine engineer at Canadian Refractories Ltd., at Kilmar, Que. He was previously at the Levack Mine in Ontario.

R. T. Lisset, formerly with Vancouver Iron Works Ltd., is now on the engineering staff of H. A. Simons Ltd.

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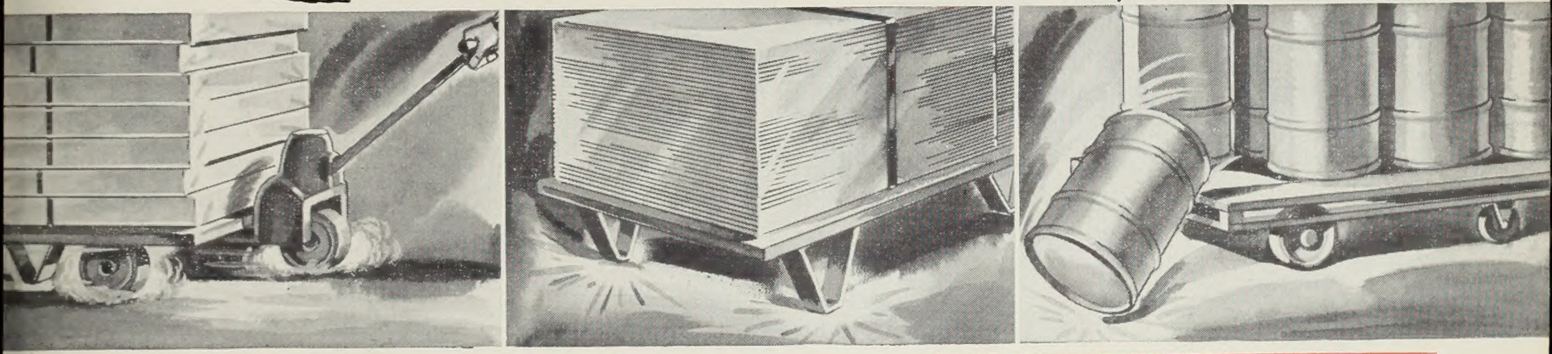

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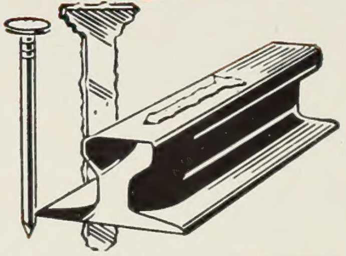

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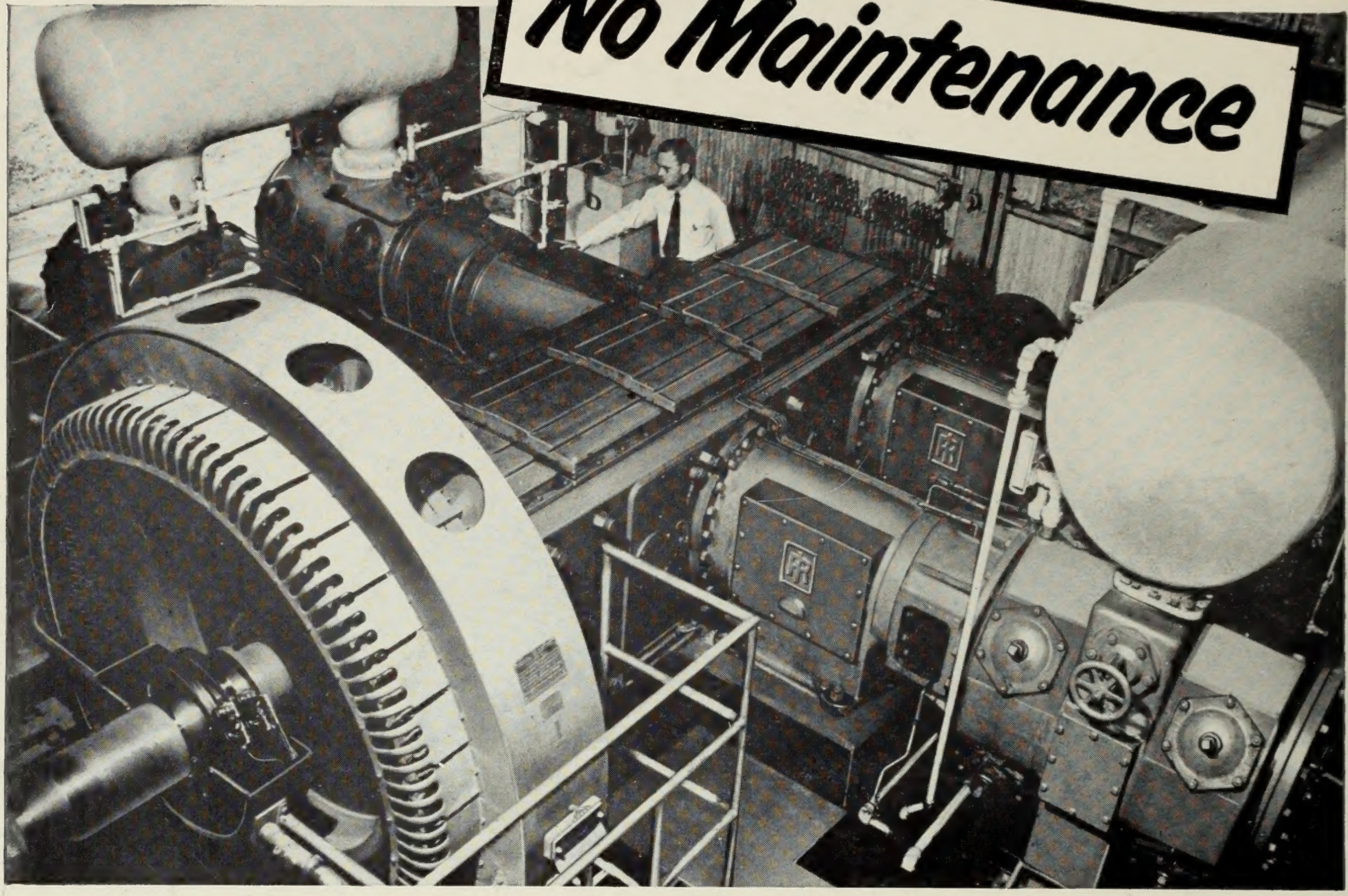
6 YEARS OF CONTINUOUS SERVICE WITH PRACTICALLY No Maintenance



2000 HP ammonia compressor gives outstanding performance at large chemical plant

Installed in 1949 this heavy-duty Ingersoll-Rand compressor has been in continuous service supplying 1200 tons of refrigeration for a large chemical plant. Driven by a 2000-hp synchronous motor, it compresses ammonia in two stages from 11 psig to 215 psig. During these six years' operation there has been practically no maintenance or replacement of parts.

Based on this outstanding performance record, the company has recently installed a 3000-hp air compressor of the same fundamental design, thus taking advantage of the interchangeability of most of the wearing parts.

If you have processes calling for compression or evacuation of air or gas you can surely benefit from Ingersoll-Rand's experience in designing and building the world's most complete line of reciprocating and centrifugal compressors. I-R engineers are well qualified to give you expert assistance, no matter what the gas, pressure, temperature or process.

IR
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